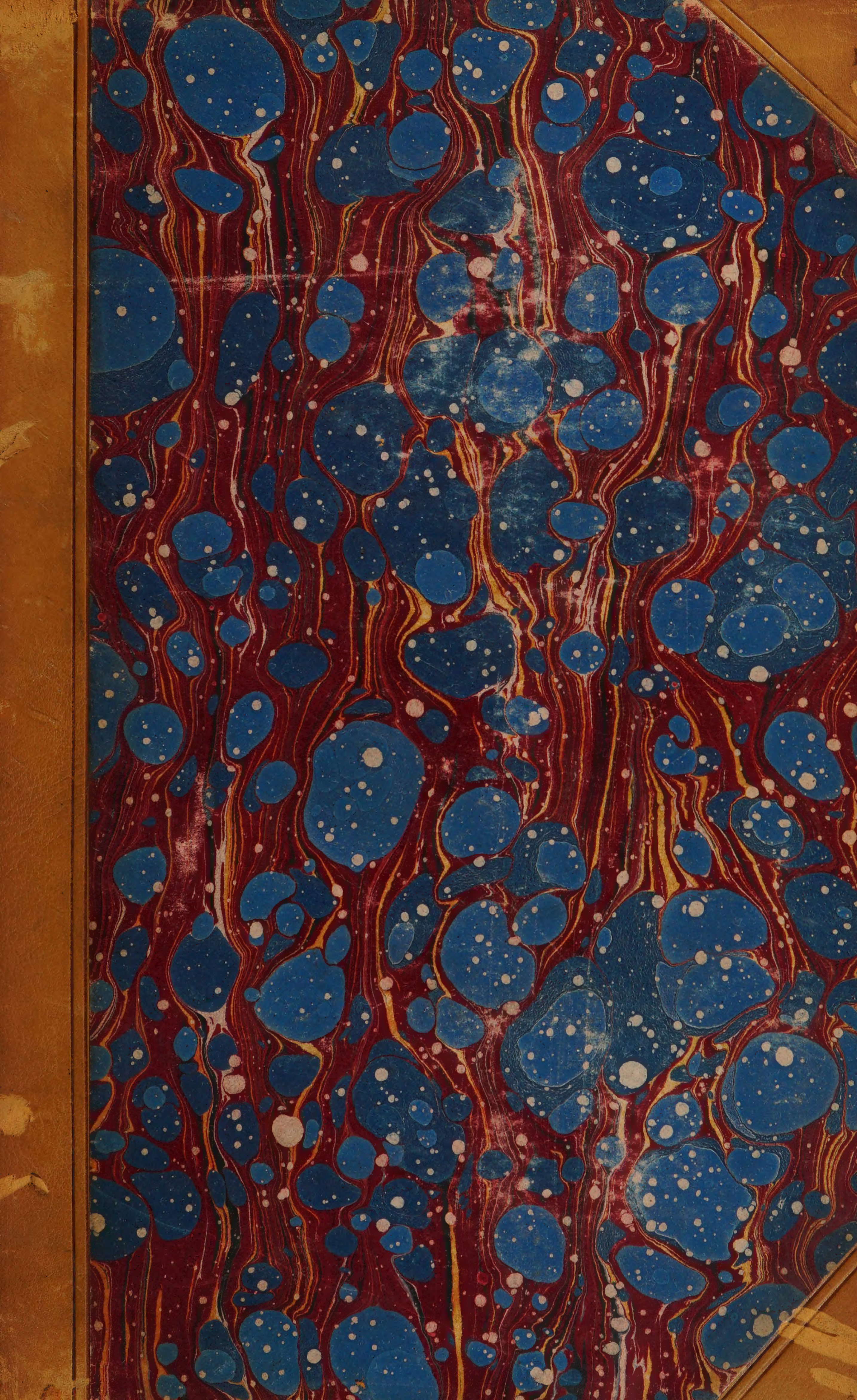

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point can any valid line of demarcation be drawn between the several forms of these malarious fevers, so numerous are the connecting links which bind them to each other (ALISON, PARKES).

SECTION IV.—MUCOUS FEVERS.

Under this heading it is proposed to group together and to consider the remaining diseases of the *miasmatic* order which are to be noticed in this text-book, and which (with the exception of *Croup* and *Dysentery*) are by some comprehended amongst the "*General Diseases.*" These are,—*Influenza, Hooping-cough, Mumps, Diphtheria, Croup, Dysentery, Diarrhœa, Cholera.*

These diseases are all attended with fever, and are characterized by irritation, catarrh, inflammation, specific lesions, or altered functions of some portion of the mucous membrane, either of the respiratory or alimentary tracts.

INFLUENZA.

LATIN, *Catarrhus epidemicus;* FRENCH, *Grippe;* GERMAN, *Grippe*—Syn., *Influenza;* ITALIAN, *Influenza.*

Definition.—*A specific febrile disease, invariable in its essential characteristics, frequently prevailing as an epidemic, attended with lassitude and prostration to an extreme degree, with special and early implication of the naso-laryngo-bronchial mucous membrane; chills and great sensibility to cold over the surface of the skin, the eyes injected and tending to fill with tears, the nostrils discharging an acrid fluid, attended with fixed and intense pain in the head, mostly frontal over the eyes, sometimes also attended with giddiness; nights sleepless, with delirium or lethargy; cough prevails, with yellow expectoration, most troublesome at night, and tending greatly to increase the headache. Fever attends the disorder, sometimes slight and sometimes severe, and of a type varying in different epidemics and localities. The duration of the fever is definite, of from four to eight days* (PARKES). *The sense of taste is generally greatly disordered, and there is great anxiety and depression over the region of the heart.*

Historical Notice.—We have no credible accounts of the existence of influenza previous to the tenth century. In 1311 it was very fatal throughout France. In 1403 the courts of law in

Paris were closed on account of the deaths. Towards the close of the twelfth and thirteenth centuries it was observed that catarrh was not only endemic in particular districts, but that it occasionally spread over large portions of country, while still later, in the year 1557, it was found to prevail epidemically, not only over the whole of Europe, but even over the whole of the northern hemisphere, beginning in Asia and proceeding westward till it terminated in America. In the eighteenth century, having advanced westward till it reached the Elbe, it passed over the intermediate countries and reached England, where the stream broke into two branches, the one crossing the Atlantic to America, while the other retrograded south-east through France, Spain, and Italy, till it was lost in the Mediterranean—a course similar to that described by cholera.

Influenza has occasionally originated as far eastward as India, but more commonly it has broken out in the north of Europe, as Moscow, Warsaw, or Dresden. It seems probable that, like the poison of Cholera Indica, its spread may be limited to a small number of primary *foci;* for we find in every volume of the *Calcutta Transactions* accounts of some catarrhal fever spreading for a season along the banks of some principal river, and then subsiding; so that it is evidently only occasionally and at long intervals *erratic,* as in 1729, 1743, 1775, 1782, 1831, 1833, and 1837. The influenza, therefore, is both endemic and epidemic; and, in the latter case, we find it, at least in Europe, spreading from east to west, prevailing in the depths of winter as well as the heights of summer, lasting nearly the same space of time in the different towns and cities it attacks, or from four to six weeks, affecting contiguous places in different degrees and at different times.

On looking to the habits of this poison, it is probable that its actions are not limited to man; for in most years, when influenza has been epidemic, a similar disease has been epizoötic, especially among horses and dogs, as in the years 1728, 1732, and 1775. It is a disease of extraordinary rapidity of progress; and as its diffusibility is great, so are its periods of recurrence frequent—those cycles of its visitation which are as yet beyond our comprehension to explain.

Pathology.—A specific poison is believed to be absorbed, and to infect the blood, when, after a period of incubation varying from one to two or three days, or even to two or three weeks, it produces disordered functions of the great nervous centres, causing great general depression, extreme debility, together with slight or severe remittent fever. The specific actions of this poison are on the mucous membrane of the eyes, of the nose, and of the bronchi; in a smaller number of cases on the mucous membrane of the fauces, causing sore throat; and in a still smaller ratio on the substance of the lungs and on the pleura, causing inflammation of those organs. In most instances the disorder terminates in diarrhœa. These different pathological phenomena vary in frequency and complexity in different seasons and places.

In most cases, when the poison is of sufficient intensity to produce fever, the type is remittent in this country, with exacerbations in the evening. Its usual duration is two, three, or four days, when it terminates in an abundant sweat, and which not unfrequently leaves great debility behind it. In Germany the fever is sometimes intermittent. At the same time, however, or, it may be, preceding or succeeding the fever, the patient has in general been seized with a slight inflammation of the ocular and nasal membranes, followed by coryza, or the serous discharge of a common cold or catarrh; and this inflammation generally extends to the larynx and trachea, or to the lungs.

The pneumonia occupied most commonly the middle and lower lobes, and only rarely the summits of the lungs. Out of forty cases observed by M. Landau, the inflammation occupied twenty-one times both lungs, eleven times the right lung, and eight times the left. The forms of pneumonia are principally serous inflammation and red hepatization, the latter occasionally interspersed with a few points of pus. Gluge states that in the fatal cases of pneumonia connected with influenza he has found exudations in the bronchia, which he can only compare to the false membrane of croup. Such exudations were seen in the hepatized portions of the lung as white, elastic, firm cylinders filling the bronchia, from the fourth or fifth divisions of these tubes, into such as are not more than a quarter of a line in diameter. The inner membrane of the bronchia in such cases was extremely reddened, but not softened.

Symptoms, Course, and Complications.—The symptoms of influenza assume a variety of different forms. Thus, catarrh often exists without the fever, and in a smaller number of cases, the fever without the catarrh. Severe nervous depression, prostration, anxiety, and præcordial oppression, were frequently the most prominent symptoms, while in other instances the bronchial affection alone harassed the patient.

The disease usually begins suddenly with chilliness and shivering, rapidly succeeded by an immediate and evident impression upon the mucous membranes of the nose, mouth, frontal sinuses, trachea, and bronchial tubes, to a greater or less extent. General soreness accompanies these symptoms, with severe, darting, neuralgic headaches, aching of the limbs, listlessness, great mental depression, complete anorexia, and an extraordinary weakness, which, in the experience of Dr. Parkes, bore a close ratio to the extent of the pulmonary affection, and consequently to the severity of the disease. These symptoms were accompanied by fever, slightly increased towards evening. Patients were usually seen about the third or fourth day, and then they were found complaining of cough, tightness of the chest, of pain in the epigastrium, and also of dyspnœa. The face was flushed, and sometimes swollen, the alæ of the nose red, the lip vesiculated, the eyes streaming with coryza, and the voice altered as in a common cold. The tongue was moist, or coated with a yellow mucus, and taste was vitiated, the skin soft and without morbid heat, the pulse little augmented in frequency. But although each of the particular symptoms might be mild, there was a languor, debility, and dejection of spirits far beyond what might have been expected, and almost exceeding that of common continued fever. These symptoms were in many instances long in subsiding. The average duration of the cases in the epidemic of 1847 (so admirably described by Dr. Peacock) was from three to five days in the mild forms, and from seven to ten in the more severe.

In mild cases such phenomena constituted the whole disease, and the patients recovered about the eighth or tenth day, after suffering for a few hours from sharp diarrhœa or profuse perspiration. In many instances, however, the patient, in addition, suffered from mild or severe sore throat; or cough came on, and continued for many weeks. In a few cases the symptoms were of a more aggravated character, the fever being more marked, the pulse accelerated, the skin hotter, and the cough more troublesome; and these conditions have often been followed by inflammation of the lungs.

The pulmonary complications may be arranged into four forms,—(1.) Capillary bronchitis; (2.) Bronchitis supervening on tuberculous disease of the lungs; (3.) Bronchitis with disease of the heart or aorta; (4.) Pneumonia.

The accession of capillary bronchitis is indicated by the chest symptoms becoming more severe and the cough paroxysmal, and the dyspnœa at first quite disproportionate to the cough and to the physical signs. The expectoration is scanty, and consists of small yellowish pellets, forming tenacious masses of a peculiarly nodulated form. The pulse becomes rapid (120—140), the tongue covered with a white-brown fur, and prostration is extreme. The only auscultatory signs are roughness of the inspiratory murmur, with occasional sibilus, and slight crepitation at the back. There is soreness and contraction of the chest, but no acute pain. Crepitation, unattended by dulness on percussion, soon extends over a greater or less extent of both lungs; and the dyspnœa speedily becomes so intense as to prevent the patient from lying down, the lividity of the lips and face increases, and the eyes become prominent. The cough is now very frequent, the sputa very viscid, of a greenish-yellow colour, without air-bells, and often streaked with blood. The respirations are quickened; but there does not appear to be any uniform connection between the extent of the disease and the disturbed ratio of the pulse and respiration movements. The general rule is, that the respirations are relatively more quickened than the pulse (PEACOCK, PARKES). The physical signs soon become modified by rapidly developed emphysema of the lungs. Generally, it may be said that the *capillary bronchitis* of *influenza* is distinguished from *pneumonia* by the greater severity of the general symptoms; by the tendency of the fine crepitation of the early stage to pass into subcrepitant and mucous râles, rather than to give place to evidences of condensation, and by the peculiar characters of the cough, which is paroxysmal, and not attended by pain; and, lastly, by the character of the expectoration, which consists of whitish viscid pellets, cohering into irregular masses, and destitute of the glairy adhesive character, russet colour, and small air-bubbles of pneumonia expectoration (PEACOCK).

Inflammation of the substance of the lungs seldom occurs till the second or third day, and more commonly not till the fifth or sixth; and, although generally, is not always preceded by shivering, or even bronchitis. The pneumonia in some years has been characterized by well-marked symptoms, as pain in the side, dyspnœa, and by purulent or sanguineous expectoration, so that nobody could mistake it; but in general the pneumonia has been adynamic in character, and presented a striking contrast to the usual symptoms, there being scarcely any local pain, the pulse, ordinarily so large and full, has been slow and small, and though sometimes counted between eighty and ninety, has ranged more commonly from sixty to seventy. The face also, instead of being full and red, has been sharp and pale, the lips blue, and the extremities cold. The patients also, who generally preserve a good deal of power in the ordinary forms of pneumonia, were now so weak that they were obliged to be supported while auscultated. Even this mode of exploring the chest did not afford the usual indications, for crepitation was rare, the respiratory murmur was heard, except in a few points, all over the chest, and there was little or no bronchophony. The auscultatory signs are in general those simply of bronchitis, dry rhonchus in some parts, and harsh vesicular murmur in others. The expectoration likewise had not the characters observed in simple pneumonia; for, instead of being purulent and mixed with blood, it was thin, transparent, and viscid, and, if fever prevailed, it was usually of an adynamic character, marked by a brown tongue, an accelerated pulse, and occasionally by delirium. Throughout the progress of this disease the symptoms of nervous derangement are much more prominent than in ordinary catarrh, and the muscular debility is great, which is the most distinguishing feature of the disease. So great is this prostration, that in some instances the patient has fainted merely by attempting to sit up. This extreme debility often continues after all other symptoms have passed away. The disease generally terminates favourably by perspiration, or by a copious secretion of mucus from the bronchia, or a copious discharge of urine, which deposits a sediment on cooling. Towards the termination of the complaint, rheumatic affections, especially of the face and head, assume an intermittent type.

Causes and Modes of Propagation.—Influenza is for the most part so universal a disease that large portions of the population of every country in which it has prevailed, without respect to age, sex, or condition, have been commonly infected. The air seems to be the main medium of propagation, rather than food or drink; and the special agent of propagation seems to be one capable of indefinite increase, continual reproduction to a greater or less extent in different places (PARKES). In general, women, from being less exposed to the weather, have suffered in a smaller proportion than men, and children less than either. In all epidemics the aged suffer greatly. According to Dr. Blakiston's results, the ages from ten to sixty furnish the most patients. The ages from thirty to forty furnish most male patients, and from twenty to thirty most female patients. In the epidemic of 1847 the mortality was greatest amongst the adults and aged. In childhood the average mortality was raised 83 *per cent.;* in manhood, 104 *per cent.;* and in old age, 247 *per cent.*

It has been remarked in several epidemics that the lower parts of towns have been more generally and more severely affected than the higher and more healthy districts. The epidemic of 1847 was much more fatal in the insalubrious parts of London than in those less unhealthy; and according to Dr. Peacock's experience, the mortality of influenza was owing more to the condition in which the disease found the patient, than to any inherent power of the poison itself—a result conformable to general experience and the returns of the Registrar-General (PARKES).

The nature of the "*epidemic influence*" which gives rise to *influenza* is quite unknown. Sudden changes of temperature appear to assist the development of the influenza poison; and exposure to cold predisposes the individual to the disease—which seems to be a disease especially of the higher latitudes.

Susceptibility Exhausted.—Few persons suffer more than one attack of influenza in the same epidemic, although many relapse; and one attack of this disease in no degree protects the constitution from a second attack in another epidemic.

Prognosis.—Children and persons under forty die in a very small proportion, unless in a previous state of ill-health. The mortality, however, among the aged has in every country been great from this disease. It has been remarked, also, that the disease, if not fatal in itself, left the patient, of whatever age, often greatly debilitated in body and depressed in spirits, and that those with tender lungs who suffered from it frequently fell into phthisis, or continued to cough for several months afterwards, so that a complete recovery was often long and tedious.

Treatment.—As a general rule, the great majority of cases in epidemics of influenza have scarcely required any medical treatment. In that of 1782 it was observed that "many, indeed, were so slightly indisposed as to require little or no medicine; nothing more was wanted to their cure than to abstain for two or three days from animal food and fermented liquors, and to use some soft, diluted, tepid drink. A lenient purgative at the beginning of the disease was useful in moderating the fever, and nature seemed to point out the repetition of it afterwards when there was pain in the stomach and bowels, and a tendency to diarrhœa. The same was observed in 1762. Nothing, likewise, was observed so successfully to mitigate the cough as a gentle purge to open the bowels, and afterwards to give a gentle opiate at night. In the year 1837 it was also remarked that, as long as the symptoms were limited to cough, hoarseness, headache, or other pains moderate in degree, the patients all recovered by putting them on a low diet, by attending to their bowels, and confining them for a few days to the house; and, if more was attempted it was quickly found that the disease ran a course scarcely influenced by medicine. A smaller number, however, required medical attendance, either from the severity of the bronchitis, the occurrence of pneumonia, of angina or of severe dyspnœa, of the disordered state of the bowels, or more frequently from the debility induced by the disorder.

Blood-letting is always hurtful. It does not relieve the fever, and increases the nervous depression. In general, when pleurisy, bronchitis, or pneumonia may supervene, leeches to the chest, or cupping, may relieve symptoms. A mild purgative dose of calomel (one to three grains) should be given once at first, followed by a saline purgative. Dark-coloured motions are brought away, the spirits improve, and the fever abates. But mercury must not be given beyond an occasional purge.

Emetics are also to be avoided. They increase depression, and are apt to produce irritability of the stomach difficult to subdue.

In the epidemic of 1847 Dr. Peacock found blood-letting of little use, except in the very early stage. It increased prostration, without benefiting in any commensurate degree the pulmonary disease. Leeches, however, were sometimes useful, and counterirritation of various kinds. During convalescence *sulphate of zinc* was found to be a useful tonic when the expectoration was thin and spumous, and alkalies more useful when it was viscid and glairy (Peacock). *Nitrate of potash*, highly diluted and mixed with lemon juice and sugar, is a most useful drink. From 60 to 120 grains in twenty-four hours may be taken. ʒj - ij

In pneumonia it has been found that although a few persons bore the loss of a considerable amount of blood, yet, in general, blood taken beyond a very limited quantity either did not relieve the complaint, or the practice was actually prejudicial. It is in this form of pneumonia that large doses of the *tartrate of antimony* have been found so advantageous. Indeed, it seems distinctly proved that this form of pneumonia will not bear that powerful antiphlogistic treatment which is necessary when it arises from general causes, and is of a more sthenic character.

When the patient was affected with angina, it yielded readily to small local bleedings when the tonsils were swollen, and to small quantities of wine when the tonsils presented little or no increase of size. The derangement of the bowels also readily yielded to purgative medicines when constipated, and when affected by diarrhœa, and accompanied by pain, to mild purgatives and opiates, or to the compound powder of chalk with opium.

But opium must be used with great caution in severe pulmonary complications. Its use ought to be put off till the later stages, otherwise it may increase the tightness of the chest and the dyspnœa. It must not be given till all danger of lung congestion is past. When the fever and other immediately alarming symptoms of the influenza had ceased, there frequently remained a teasing cough, and the convalescents in general complained of languor, want of appetite, and that their sleep was broken and unrefreshing. For removing these complaints, change of air and riding on horseback were most effectual, and to some they were absolutely necessary; and, in addition to these, mild tonics, or the natural chalybeate waters drank at the spas, were of singular service. In slight cases it was sufficient to limit the patient to white fish and puddings, and in the more severe forms to slops and light puddings. The night air was universally prejudicial. It does not appear that any precautionary treatment was of service in preventing the spread of this disease among the attendants on the sick.

Nov 22/69

HOOPING-COUGH.

LATIN, *Pertussis;* FRENCH, *Coqueluche;* GERMAN, *Keuchhusten*—Syn., *Stickhusten;* ITALIAN, *Tosse convulsa*—Syn., *T. canina.*

Definition.—*An infectious and (sometimes epidemic) specific disease, preceded and accompanied by fever of variable intensity; attended in the first instance by catarrh, and subsequently by paroxysmal fits of coughing, which occur in numerous short, rapid, spasmodic, convulsive movements of expiration, suddenly followed by a prolonged inspiration, marked by a characteristic sound of a sonorous kind, and variously named the "kink," "hoop," or "whoop." These paroxysms of expiratory and respiratory convulsive movements alternately recur several times, till the fit ends by a quantity of mucus being brought up from the lungs, or till the contents of the stomach are evacuated.*

Pathology and Morbid Anatomy.—The theory of this disease is that a specific morbid poison produces slight primary fever, which for the most part subsides on specific or secondary actions being established. These are catarrh, followed by a peculiar cough and vomiting, ascribed to irritation of the *vagus nerve* by the specific poison. The disease is a "specific pulmonary catarrh;" but very different opinions have at various periods been entertained as to its nature. Its origin appears to have been comparatively of no very distant date, Sprengel not having been able to trace it beyond 1510, when it was endemic in Paris; but its epidemic character was not determined till 1580.

Like other diseases of this class, it appears, as a rule, but once during life, and attacks chiefly infants and children. Dr. Watson gives an instance of a child born with hooping-cough. There are instances, however, of its occurring not only late in life, but also a second time (HEBERDEN). Blache gives a remarkable instance of a grandfather and grandmother catching hooping-cough a second time from their grandchild, all of them labouring under the disease together. Some consider the disease to be a specific affection of the nervous system; others, that it is a catarrh; but both these pathological conditions co-exist in hooping-cough. Inflammation does not necessarily accompany the disease, although a state of the mucous membrane exists by which it is morbidly irritable, or susceptible to impressions.

Pathologists have also ascribed the complaint to a morbid condition of the pneumogastric nerve—an explanation supposed by some to be confirmed by the circumstance that that pair of nerves is sometimes found red, with the medullary matter altered in colour, dense in texture, and of cartilaginous firmness (Kilian, Autenrieth). Others believe that a specific poison acts on some part of this nerve (Todd).

The results of nineteen *post-mortem* observations made by Dr. Graily Hewitt during a recent epidemic of this disease (1855), in children varying from one month old to four years, showed the chief lesion to be collapse of the lung-substance—a condition also known under the various names of *fœtal condition*, *carnification*, and *atelectasis.* The experimental test to detect the presence of this morbid collapse is that suggested by MM. Bailly and Legendre, and consists in inflating the lung, the effect of which is to produce uniform distension in a simply collapsed lung; but the force necessary to distend the carnified parts is more considerable, and some portions are not capable of inflation by any force. The air-cells most distant from the roots of the lungs were most liable to this change, and the margins of the lungs were chiefly affected; and there is generally emphysematous distension of the air-vesicles adjoining the collapsed portions of these organs.

Other pathologists have ascribed the disease to cerebral irritation (Webster in *Medical Gazette*). But facts tend to show that the cerebral symptoms are effects, rather than the cause of the disease. In short, the formation and development of *hooping-cough* seem to follow as the result of a specific poison of an unknown kind, but which is communicated through the atmosphere, and seems to affect directly the nervous system and the pulmonary mucous membrane, like *influenza* and *measles*, and, like them, the disease sometimes becomes epidemic.

Symptoms.—It is observed that, in the majority of cases, hooping-cough commences like a simple catarrh, alike in children and adults; afterwards, however, the nervous element of the disease predominates and is combined with the catarrhal element. In the first instance high fever, and the secretion of a viscid mucus from the bronchial mucous membrane, with repeated paroxysms of coughing—several times in a minute—and continuing for many days, or from one to two weeks, are sufficient to indicate a specific catarrh, as distinguished from an ordinary cold. In some cases, again, the nervous element of the disease is mostly developed; so that from the very commencement a kind of *hiccough* exists, or "spasms in the throat," from the efforts to inspire, causing a whistling through the larynx. The paroxysms of coughing are thus more frequent, obstinate, and severe in hooping-cough than is usually the case in a common cold; and the patient has also a more troublesome sensation of tickling in the throat and inside the trachea—the commencement of the nervous element of the disease—which eventually becomes so characteristic. The catarrhal symptoms may last for several days—three to fourteen,—or even for several weeks—one to four (WILLAN, TROUSSEAU); six to eight (LOMBARD)—before the specific convulsive cough supervenes; and in some instances, where all the other symptoms are present, the convulsive cough may be absent. The fever of invasion is also characteristic of hooping-cough. It is of greater intensity and of longer duration than the fever of an ordinary catarrh. It may last from seven to fourteen days; while the fever of a simple catarrh is rarely prolonged beyond two or three days. In the first stage of the disease it is the incessant repetition of the cough which is most characteristic; in the succeeding stage, when the cough becomes convulsive, the incessant repetition subsides, the cough recurs less frequently, and is more convulsive. A sensation of tickling or prickling in the larynx and trachea is the indication of a convulsive cough coming on; and no doubt this is the warning which young children recognize and dread as the harbinger of a paroxysm, which suggests to them the necessity of seizing something for support during the fit of coughing, which almost immediately commences. The irritation is attempted to be got rid of by coughing; and in the expiratory efforts the air is expelled with great violence, and so repeatedly and irresistibly that the lungs are ultimately almost emptied of air. At the conclusion of these expiratory efforts the condition of the lungs resembles that produced by *asphyxia*. A sudden inspiration now necessarily and suddenly follows, the air being drawn through the glottis by the gasping patient, with a force and velocity which gives rise to a shrill, sonorous sound, not unlike the crowing of a cock, and which has been variously named a *kink*, a *hoop*, or *whoop;* and the disease has accordingly received various names, such as *kink-host*, *hooping-cough*, *whooping-cough*, *chincough*. The anxious and distressing inspirations are scarcely completed when the convulsive expirations of the cough are again renewed, and again followed by the gasping and crowing inspirations, till a quantity of mucus is brought up from the lungs, or till the contents of the stomach are rejected by vomiting. Such are the phenomena of the fit or paroxysm of hooping-cough. After it is over, the patient in ordinary cases appears to be but little affected, and returns immediately to play, or to any other occupation which takes the attention at the time.

When these phenomena are prolonged, secondary effects are produced, whose morbid appearances have been noticed. The immediate consequence of the violent fits of coughing is to interrupt the free transmission of blood through the lungs, and the return of blood from the vessels of the head. This causes not only the turgidity, swellings, redness, and lividity of the face and eyelids which attend the fits, but also the discharges even of blood from the mucous surfaces of the nose, ears, or eyes. The little sufferer may shed tears of blood.

Hooping-cough varies greatly in intensity, and most authors divide the group of symptoms into three stages. The first stage (1) comprehends the period from the first symptoms of illness until the "*whoop*" confirms the convulsive nature of the cough. This is the period of development or evolution. The second stage (2) commences as soon as the nature of the cough is determined, and lasts till the violence of the cough and the danger of secondary complications is past. This is the period of spasmodic paroxysms characteristic of the disease. The third stage (3) comprehends the convalescence of the patient, until the final and happy termination of the disease; or the occurrence of any event which may destroy the sufferer.

When the convulsive stage of the disease is fully formed, and the series of fits or paroxysms of severe coughing occur at uncertain periods, during the interval the patient generally enjoys his usual health, recovers all his gaiety, returns to his play, and relishes his food with a good appetite.

A paroxysm or fit of hooping-cough comprehends the following phenomena:—

The approach of the fit is notified to the patient by an unpleasant titillation of the glottis, by a sharp pain in the chest, or by a spasmodic contraction of the diaphragm. As soon as the child is thus warned, he instinctively ceases from play—his spirits suddenly droop, and he runs to his nurse, and either grasps her arms, or lays hold of her chair or her dress, to support himself during the paroxysm, which in a few minutes or seconds is about to follow. In severe cases the cough is quite convulsive, and so rapid is the action of the diaphragm, that the air is almost instantly expelled from the lungs, and the patient, half-suffocated, turns black in the face, and frequently passes urine. At length the crisis approaches, the diaphragm relaxes, and a violent inspiration follows, accompanied by the characteristic *whoop*. This sound perhaps remits, but after a few seconds returns; and thus convulsive inspirations and expirations continue, till the patient is at length relieved by a copious expectoration, or by vomiting. The matters expectorated from the lungs are frequently thick, ropy, and viscid; or a colourless liquid. When vomited from the stomach, the patient throws up a glairy fluid of much tenacity, semi-transparent, and frequently amounting to the greater part of a pint; and should he have recently eaten, the food returns with it. It frequently happens, however, that the stomach retains the food and rejects the offending matter. If the fit be violent, the fluid rushes not only from the mouth, but also from the nostrils; and in some instances is mixed with blood, for blood occasionally bursts forth in considerable quantities from the congested vessels of the mouth, the nostrils, the ears, the eyes, and in some instances from the rectum. Such cases are most severe.

If the stethoscope be applied to the chest previous to the fit, the mucous rhonchus common to catarrh may exist, yet in most cases the respiration is natural. During the act of coughing the respiration appears completely suspended, and is not sensible to the ear in any part of the chest. On the "*whoop*," however, taking place, the air is heard to rush with remarkable violence into the trachea; but at this point it stops for one or more seconds till the bronchial tubes relax, and the air is then admitted into the lungs.

No

The fit having subsided, the eyes, which seemed to have started from their orbits, resume their natural position, but are inundated with tears, or the conjunctiva is more or less gorged with blood; the natural expression and appearance of the countenance returns, and in a few minutes, in favourable cases, the good spirits of the little patient are renewed, and he eats with appetite. On the contrary, in severe or unfavourable cases, long-continued exhaustion, headache, and some fever, are the preludes to convulsions, inflammation, or the other more severe complications of the disease.

The paroxysm varies greatly in frequency and severity, but, in general, its frequency is as its severity. In ordinary cases it returns every two hours; but in severer cases, and especially during the second and third week, it returns every half or every quarter of an hour, or even oftener. This disease commonly reaches its acmé at the end of the third, fourth, or fifth week; after which the paroxysms diminish in frequency, the intervals are prolonged, and the patient is to a certain degree convalescent. The duration of this second stage is from two to six or eight weeks.

The third stage commences with the convalescence of the patient, when the paroxysms become milder, the intervals longer, the expectoration thicker and more opaque, greenish, or pus-like, and more like ordinary catarrh. The vomiting ceases, and the general health of the patient begins to improve greatly. The duration of this stage, however, is often long and variable, and the cough may still harrass the patient for many weeks, or even many months. It is to this stage that the term chronic is usually applied.

The disease lasts from six to eight weeks; but there are exceptional cases, which on the one hand get well in a week, and on the other hand may continue several months, or even a year. "The general duration of the disease is directly proportionate to the duration of the prodromata;" and the more quickly the convulsive cough makes its appearance, the more quickly does the disease subside (TROUSSEAU).

Many accidents may arise to complicate the symptoms of hooping-cough, and to increase the danger, as inflammation of some of the tissues of the lungs, of the mucous membrane, of the stomach or intestines, or of the serous membranes of the brain.

Inflammation of the minute bronchia is the most usual complication of this disease—*capillary bronchitis*, or *peripneumonic catarrh*. The form of inflammation may be that in which the secretions are in defect, so that the mucus is not only greatly diminished in quantity, but is thick and viscid, teasing the patient with fruitless efforts to free it from the air-tubes, and thus causing a frequent recurrence of the paroxysm. In other cases it may assume the form of purulent inflammation, the pus secreted being formed into sputa, and moderate in quantity; or it may be thrown up pure, as from an abscess, and so enormous in quantity as to amount to one or two pints in the twenty-four hours. The inflammation of the bronchial membrane may spread to the substance of the lungs, when the danger, as well as the symptoms, of some of the various forms of pneumonia will be added to the disease; but the most formidable accident is when the pleura is inflamed, for then the patient's sufferings during the paroxysm are fearfully increased, from the agonizing pain inflicted during the paroxysm of the cough. These lesions are the most frequent causes of death in cases of hooping-cough.

The mucous membrane of the stomach and intestines is often the seat of inflammation; and this is denoted by pain in the epigastrium, and by the suppression of the glairy fluid thrown up by vomiting, so that on the termination of the fit the patient often lies in a state of complete exhaustion, unable to discharge anything either from the stomach or lungs, or even to "*whoop*;" and he is then said, in popular language, to labour under the "*dumb kink*."

In mild cases the bowels are little affected in this disease, except that the patient sometimes passes his fæces during the paroxysm. In severe forms the stools are often either black and offensive, or they consist of a colourless mucus, the latter evidently depending on an inflamed state of the mucous follicles.

Headache is a symptom which usually attends the catarrhal stage, but generally ceases when the fever subsides. In some instances it continues throughout the disease, and is not unfrequently the forerunner of fatal convulsions, or epilepsy, or of inflammation of the membranes of the brain, terminating in delirium, coma, hydrocephalus, and death.

Diagnosis.—It is impossible to determine whether the febricula of the first stage is the result of simple catarrh, or will, on its subsiding, prove to be hooping-cough. The earliest recognition of hooping-cough is by the *obstinate coughing*. A cold giving rise to paroxysms of coughing recurring fifteen, twenty, or thirty times in a minute; and which continues in this manner for four to ten days in succession, attended with high fever, is certainly a specific catarrh; and after a period varying from one to two weeks later hooping-cough will manifest itself with its well-marked characteristics (TROUSSEAU). As soon, however, as the cough has been followed for two or three paroxysms by *the* "*whoop*," the diagnosis is perfect, no other disease being accompanied by this symptom.

Cause and Modes of Propagation.—That hooping-cough is induced by a specific poison there is little doubt; but in what manner this agent is generated is not determined. The disease is always sporadic, sometimes epidemic, and the "epidemic influence" is the most common cause and mode of propagation.

The predisposition to the disease is so strong that few persons pass the period of childhood without suffering from it; but it may occur at any subsequent age. The early age at which the large majority of patients pass through the disease is, however, a sufficient reason for our very slight acquaintance with the predisposing causes.

When hooping-cough is once excited, the patient evolves a poison which is both infectious and highly contagious, communicable from one human being to another—a fact which necessarily implies the idea of "specificity." The general public are so unanimously of opinion that this disease is infectious, that no parent will permit his yet unaffected child to mingle with such as may be labouring under it. The profession are, with a few exceptions, of a similar opinion; and it is probably most contagious at the period of its highest development.

The infecting *distance* of the poison must be considerable, from the utter impossibility of isolating the patient at home, or of preventing the spread of the disease in schools.

Rosen conceives that, without being aware of it, he has often carried the disease from house to house. Frank also says that it is often propagated from patient to patient, from house to house, and from village to village. In Geneva, Lombard has often traced the first cases occurring in that city to a neighbouring town, or to a sick child from the country. Hooping-cough was some years ago introduced into St. Helena, where it proved very fatal: the captain of a ship, having some children labouring under the disease on board, allowed their dirty linen to be sent on shore to be washed, and so introduced the disease among the inhabitants.

The poison of this disease may co-exist with many other poisons, and in this case they often greatly influence each other's actions. *Small-pox* and *hooping-cough* have often co-existed; and a very common and fatal combination is *measles* and *hooping-cough*. *Hooping-cough* and *cow-pox* are not unfrequently combined. Indeed, the lower classes erroneously look upon vaccination as in many instances a cure for *hooping-cough.*

Period of Latency.—The disease has a stage or period of incubation, but our knowledge of the extent of this period is at present extremely imperfect. The disease never shows itself immediately after exposure to contagion, but a certain number of days (five or six) elapses before the symptoms of catarrh are to be observed.

Prognosis.—The proportionate number of deaths to recoveries in *hooping-cough* is not determined, but greatly varies in different years; for in one year hardly a death will occur from the disease in a large city, while in another year many children will die. In general, however, the milder forms of the disease are rarely fatal, while the more severe and protracted cases very commonly are so. Lombard thinks station in society greatly affects the mortality; for he says that of ten fatal cases nine belong to the poorer classes. The reports of the Registrar-General show that the mortality is greater from this disease in towns than in the country, being in the metropolis, in 1838, ·111 *per cent.*, while in England and Wales it was ·061. In the year 1839, also, it was for the metropolis ·061 *per cent.*, while for England and Wales it was ·053. Lombard gives the ages of forty fatal cases as follows:—

AGES.	CASES.	AGES.	CASES.
From birth to 6 months,	6	From 4 to 5 years,	2
,, 6 to 12 months,	7	,, 5 to 6 years,	2
,, 1 to 2 years,	10	Above 6 years,	0
,, 2 to 3 years,	6		—
,, 3 to 4 years,	7	Total,	40

Danger from bronchial inflammation is to be dreaded rather towards the end than the beginning of the disease. Convulsions are apt to occur if dentition is going on at the time; and if they arise from the congestion or effusion within the cranium, the case is generally fatal. The number of paroxysms which a child may have in twenty-four hours is the best basis of prognosis. Twenty fits in twenty-four hours denote a very mild case; when more violent, forty to fifty paroxysms may occur in that period; and when the number of paroxysms exceeds forty, the case is a serious one, and prognosis grave.

If a predisposition to tubercle exists, *hooping-cough* may determine the development of *phthisis.*

Ext Belladonn gr $\frac{1}{8}$ – $\frac{1}{10}$
Ext Hyosc grss
Syrup Papav m v – x – xv

Treatment.—On the invasion of the disease, beyond putting the patient on a low or very moderate diet, and attending to the daily action of the bowels, there is little occasion for medicine.

The "*whoop*" having confirmed the nature of the affection, and the second stage being established, the disease will run its course, and one of two indications of treatment may be followed. The first is to prevent, if possible, convulsions, or any attack of inflammation, either of the lungs, the stomach, or of the membranes of the brain. The second indication, after the period of danger is past, is to prescribe such medicines as may diminish the frequency of the paroxysms. Indeed, the best mode of obviating the danger of cerebral irritation, or of inflammation of any of the organs that have been mentioned, is to mitigate and control, as far as possible, the frequency of the paroxysms, to check those secretions which are in excess, and to excite those which are in defect, and these objects are best obtained by mild sedatives, combined with gentle purgatives or laxatives.

The choice of the sedative has been considered a matter of much importance. The continental physicians have bestowed much praise on *belladonna*, others on *hemlock*, others on *henbane*, while some have contented themselves with *opium*. It must be admitted, however, that none of these narcotics possess any specific property in controlling this disease, so that the selection of the particular one must be left to the discretion of the practitioner. But supposing the patient to be a child, as the head is especially the organ to be protected in such cases, the mildest sedatives, such as *hyoscyamus*, or the *syrup of poppies*, are the safest and best. Should, however, *belladonna* be selected (as it seems to be the most efficient sedative), if the child be under *four* years of age, the dose ought not to exceed *one-eighth* or *one-tenth of a grain* of the extract, with the same quantity of the powder of the leaves in a pill, the pill being dissolved in syrup at the time when it is to be administered (TROUSSEAU). The dose should be given in the morning; and only once daily, commencing with one pill, and increasing to two or more. Or if *hyoscyamus* is chosen, *half a grain to a grain* every six or eight hours; while, if it be the *syrup of poppies*, this medicine should be given in such *fractional* doses of a *drachm* as are suited to the age. *Powdered belladonna root* has been recently recommended by Vollaut. The dose is *one-fifth* of a grain, given at first *once*, then *twice*, then *four times*

[illegible]

a day, and so on until the paroxysms begin to subside, when it is to be given at much longer intervals. Thus, he says, the spasmodic period may be positively arrested in three or four days. The powder of the leaves he considers to have little efficacy (*Syden. Society Year-Book*, 1862). Infusion of wild thyme, slightly sweetened and mixed with gum, is also said to effect great improvement in cases of spasmodic cough, (JOSET, l. c.) *Cochineal* is an anodyne which sometimes affords relief. It is usually prescribed in the form of a mixture, consisting of *cochineal*, 10 *grains; subcarbonate of potash*, 20 *grains; sugar*, ¼ *oz.; water*, 4 *oz.; rub together and strain* (Squire's *Companion to the Pharmacopœia*, p. 62). Of this mixture, a quarter of a tea-spoonful four times a day is sufficient for a child one year old; half a tea-spoonful for a child of two years; and a tea-spoonful for a child of four years. Boiled apples in milk should be given for food.

An opiate, in the early stage of the disease, ought not to be administered alone, and some purgative or laxative ought, as a general rule in all cases, to be combined with it. The selection of the particular medicine is perhaps unimportant, and any vegetable or saline purgative will perhaps answer equally well, as the *confectio sennæ, rhubarb, castor oil*, or *manna*. The neutral salts, however, sit easiest on the stomach, and (as the medicine must be continued) are the most agreeable to the patient. *Opium* is a dangerous remedy, and is liable to the objection of being apt to check the mucous secretion.

If at the outset or afterwards the cough is very suffocative, an emetic is useful. Five to nine grains of sulphate of copper dissolved in three ounces of distilled water, and a dessert-spoonful every ten minutes is the most efficient (TROUSSEAU).

Nitric acid, in the following formula, has been found of service:—

Acid. Nitrici diluti *ƒ*ʒxii.; Tinct Cardam. comp., *ƒ*ʒiii.; Syrup, *ƒ*℥iiiss.; Aquæ, *ƒ*℥i.; *misce*. Of this mixture, one or two small tea-spoonfuls may be given every two hours (GIBB).

Towards the close of the second stage the symptoms may become unfavourable, and cerebral irritation, with convulsions, or inflammation of the membranes of the brain, of its substance, or of the tissues of the lung, or of the alimentary canal, may complicate the disease, and then the treatment of the case is always exceedingly difficult, and frequently unsuccessful.

If convulsions should come on suddenly, and without headache or other symptom of inflammatory action, small doses of any opiate, and *mustard poultices* to the feet, may relieve the patient; but should convulsions still continue, an *asafœtida injection* may be administered. It often happens that convulsions are combined with a suppression of the vomiting, and of the usual glairy discharge; and in these cases *leeches*, followed by a large *lintseed poultice*, should be applied to the epigastrium. If the unfavourable symptoms should advance, and headache or other symptom show an affection of the membranes of the brain *leeches* should be applied to the temples and *cold* to the head.

When the poison excites inflammation of the tissues or substance of the lungs, *bleeding* to a limited amount by leeches may be required; but we should be satisfied with such mitigation of the symptoms as may obviate immediate danger, and even that is not always obtained, since the affection is not to be subdued by bleeding, as in simple inflammation; for, being dependent on the action of a morbid poison, it will run a definite course. Blache bled in nine cases, either with the lancet, by leeches, or by cupping, and in one case no less than five times; yet, he adds, with a desolating want of success, and eight out of the nine cases terminated fatally. This result makes him add an axiom, in which every practitioner will agree, that there is in severe *hooping-cough*, as in *typhus, cholera,* and many other affections, an unknown element which modifies and gives a specific character to all these intercurrent inflammations.

If the intestinal canal be affected, some purgative, combined perhaps with *calomel,* may be necessary to act on the bowels and free them from their contents; and if the stools be white and muciform, and the patient not relieved, an enlarged state of the follicles may be suspected, and consequently a *lintseed poultice* should cover the abdomen for some hours, preceded, perhaps, by an *enema of syrup of poppies* and *barley-water,* and which should be administered night and morning. Many other modes of treatment have been recommended for the cure of hooping-cough, and more especially by *emetics* repeated every second day. For obvious reasons such a method is not to be recommended.

The disease having passed into the third stage, and the inflammation or other threatening symptom, if any has existed, having subsided, it is desirable to attempt to abridge the duration of the cough, which often extends to a most distressing length; and for this purpose *tonics, antispasmodics, counter-irritants,* and other remedies, either externally or internally, have been recommended.

The more stimulant antispasmodics, as *asafœtida, musk, castor, oil of amber, cantharides,* and *camphor,* are the remedies which have obtained the most suffrages in the cure of this stage of hooping-cough. The two first are in most esteem; and some persons even considered *asafœtida* to be a specific, not only in this, but in every other stage of the disease. It should be given in emulsion, in the dose of one or two grains to a child two years old, repeated three or four times a day, or even as often as every two or three hours. Cullen, however, preferred *cinchona* to *asafœtida,* and considered it "the most certain means of curing the disease." Many other remedies have been mentioned, as *alum, hydrocyanic acid, oxide of zinc, arsenic,* and many preparations of *iron,* and all of these remedies have been found to a certain extent useful as tonics; but in estimating the results of remedies, we should be careful not to mistake temporary recovery for cure; and the fact of so very many remedies being highly spoken of suggests doubt as to the value of either.

When internal remedies have failed to make any impression, the cure is often attempted by means of local treatment, or by derivatives. The early physicians applied *actual cautery* to the nape of the neck; the modern ones, *blisters* to the spine, or directed the back to be rubbed with the *unguentum antimonii cum potassio tartarizati,* or with some liniment or embrocation, as the liniment of *camphor* or of *ammonia,* or with *asafœtida, oil of amber, oil of turpentine,* or the *tincture of cantharides.* The general opinion, however, is, that these do little good unless they contain some opiate, whose absorption they facilitate, and this is attended with danger. Foot baths and the warm bath have also been used, and often with much efficacy.

When ordinary remedies have failed, a change of air is a resource of great value, and was first mentioned by Dr. Forbes, in his thesis *De Tussi Convulsivi,* in 1754; and since that period it has been recommended in dangerous cases by most physicians with that praise it so eminently deserves. While it is determined that a change from the bad air of a town to the purer air of the country is at all times a great benefit, Lombard contends that he has found a change from the country to the town to be not less beneficial, and that the patient is benefited even by the removal to so short a distance as half a mile. Indeed, it is impossible to witness more striking instances of the advantages of treatment than we occasionally observe in patients when removed from large towns to their environs, for even in a few hours they have been known to recover from an apparently hopeless state. A sail across a river is also beneficial, although the distance may be short.

Dietetic and General Treatment.—The patient should not be allowed animal food from the commencement almost to the termination of the disease *in its acute form.* It is desirable also that the temperature of his apartment should be regulated, and that he should not be exposed to any considerable or sudden change from heat to cold. In mild weather also, if no local symptom forbids, he should be permitted to take exercise in the open air. He should likewise wear flannel.

There are no known means of prevention, except an entire removal from every source of contagion.

MUMPS.

LATIN, *Parotides;* FRENCH, *Oreillon;* GERMAN, *Ziegenpeter*—Syn., *Mumps;* ITALIAN, *Parotitide.*

Definition.—*An inflammation of the parotid and salivary glands, probably specific, and certainly in some cases contagious and epidemic.*

Pathology.—It is most common in male children; and is less frequent after puberty; and second attacks of the disease are rare. The disease is sometimes epidemic, and in certain localities it prevails rather than in others; so that local causes may have to do with its propagation and maintenance.

The disease often occurs also in the course of severe fevers (typhus and enteric); and it has been noticed in cases of cholera. It is a result also of ptyalism from iodine or from mercury. Dr. John Harley gives the following example of its direct propagation from person to person. "A medical student had *mumps* in London, at a time when his mother was staying with him. They remained in town till the swelling disappeared, and then went—

a hundred miles into the country—home. There was no *mumps* in that neighbourhood; but a fortnight after their arrival one of the children was taken with the disease, and it afterwards successively affected, at regular intervals of a fortnight, each member of a large family" (Hooper's *Physician's Vade Mecum,* 7th edition, p. 558).

Symptoms.—Febrile phenomena, associated with pain and uneasiness in the region of the parotid. The pain on moving the jaw soon becomes so great that mastication becomes impossible in severe cases. Considerable fulness and soreness prevails at the angle of the jaw over the malar region and region of the parotid, on both sides generally. Beneath one or both ears redness prevails, with pain on pressure; and the pain becomes so great as to prevent sleep at night in severe cases; and in such cases the swelling generally extends to the submaxillary glands, and to the tonsils, and neighbouring parts of the pharynx, so that swallowing becomes very difficult and painful. The region of the swollen glands becomes tense and glossy; sometimes of dusky livid hue; and when both sides are affected at the same time, the face is of an enormous size; and continues so for four or five days, after which it gradually subsides, and resolution ensues, the fever and pain gradually subsiding. It is rare that the inflammation ends in suppuration. Occasionally during the course of the disease, but generally towards its subsidence, the testicles swell, or the mammæ in the female; and in some cases the cerebral membranes become implicated—as also the gastro-enteric mucous membrane.

Treatment.—Constant hot fomentations (after leeching in severe cases) should be applied to the swollen parts. The maintenance of a constant but gentle action on the bowels, by saline cathartics, must be attended to. Absolute rest ought to be enforced, and a farinaceous diet enjoined. The disease runs a definite course, and is not likely to terminate unfavourably.

DIPHTHERIA.

Latin, *Diphtheria;* French, *Diphthérite;* German, *Diphtherische Entzündung der Rachenschleimhaut*—Syn., *Diphtheritis;* Italian, *Difterite.*

Definition.—*An acute specific general disease which runs a quick and definite course in eight to fourteen days. Its anato-*

mical character is, spreading inflammation of the mucous membrane of the pharynx, attended by exudation of lymph, also by swelling of the submaxillary and cervical glands, and of the spleen. The disease is attended with great prostration of the vital powers; by a very early appearance of albumen in the urine, which may continue for a very short time only, or may become persistent. In some cases a remarkable series of nervous phenomena are apt to supervene, characterized by progressive paralysis, and sometimes by fatal syncope. A membranous exudation similar to that which appears on a mucous surface occasionally also appears on a wound.

Historical Notice.—Diphtheria is by no means new to England; and the writings of the older physicians prove that from time to time it has been epidemic, or at least very common in many parts of England. The historical accounts of the disease show that it has preserved its essential character and nature from age to age. Ever since the end of the "sixteenth century, diphtheria has been observed in every region of the Old and New World." At first it continued for a time in Spain; and during nearly forty years was noticed in different parts of the Peninsula. Rather later, all Italy was successively afflicted by it. Towards the middle of the last century especially, epidemics of the disease have occurred, less general and less prolonged, but more multiplied, in England, in France, in Sweden, and in America, and particularly at New York and Philadelphia. It terminated the life of the celebrated Washington, and of the Empress Josephine. The outbreaks have usually been limited in extent, sometimes not spreading beyond a single dwelling, building, village, or quarter of a large town. It prevailed as an epidemic in the north of France and south of England in 1859, to a considerable extent; and since that time many excellent monographs have been written on the subject in our own country, among which those of Hunter Semple, Chatto, Wade, Ernest Hart, Greenhow, Sanderson, and Jenner are conspicuous.

Pathology and Morbid Anatomy.—In this disease, as in many others of the *miasmatic* kind, the *general* or the *local* symptoms may predominate, giving special features to each case; and the patient may die from the severity of the general disease, or from the severity of some one of the local lesions.

The mucous membrane covering a tonsil may be the primary seat of the characteristic local exudation, or the arches of the palate, or the posterior surface of the soft palate, the uvula, the nares, or the pharynx may be the primary seat. At first there is redness and swelling; and the normal mucous secretion is so altered in its physical properties that it adheres by its own increased viscidity to the mucous membrane. A white or grey patch now forms on the membrane, which indicates the presence of a layer of lymph on the reddened surface.

The layer of lymph may thus spread from one or from several centres over the reddened surface; and this redness may involve the whole mucous membrane within reach of the eye. The lymph which grows upon this reddened surface may descend into the larynx, the trachea, and the bronchi. Dr. Stokes has recorded a fatal case, in which the tongue, tonsils, pharynx, epiglottis, larynx, trachea, and right bronchus were more or less thickly coated with the deposit, even as far as the fourth or fifth bronchial ramification, while the left bronchus remained quite free from it. The right lung was œdematous and consolidated, the left comparatively healthy (*Dub. Jour. Med.*, Feb., 1863). Dr. Jenner has known the diphtheritic exudation to extend into the œsophagus and stomach (*Diphtheria; its Symptoms and Treatment*, by Dr. Jenner, p. 4). If the lymph be torn from the mucous membrane, a raw, bleeding surface is exposed, which in a few hours is again covered by a new layer of lymph. The lymph of diphtheria has a variety of appearances. Sometimes it is granular, with very little consistence or tenacity. Sometimes the part is covered with a pulpy substance of a white or grey colour; but this pellicle is constant in some form or other, and is possessed of the power of reproducing itself. It is this specific exudation which establishes the disease as one *sui generis*, and to which Bretonneau gave the name of "*Diphtheritis*," and which has been subsequently modified to "*Diphtheria*." The latter term has the advantage of being the shorter word, and is that adopted by the Registrar-General. Etymologically, the terms are derived from *διφθέρα vel διφθερίς*, signifying the prepared skin of an animal; while *διφθερίτης vel διφθερίης* signifies that which is covered with a fur, or with a leathern coat.

In microscopical characters it does not appear that this "fur," "pellicle," or "false membrane" of diphtheria can be distinguished from the concrete exudation on blistered surfaces, or that which forms in the angina of scarlatina (Empis). The commencement of the formation of the pellicle is in reality an act of coagulation. The mucous membrane exudes, in the first instance, a fluid in which the *fibrin* or *mucin* coagulates; and such coagulated material forms the tube-casts which line the surface of the larynx and trachea, but from the mucous surface of which they come to be separated by a considerable interval; and generally it may be stated that there is the greatest possible variation as to the extent, the consistence, the colour, and adherence of the pellicle. Sometimes the particles of lymph are so thin, soft, and separated from each other, that the term membrane can scarcely be correctly applied to it. At other times it is tough, elastic, and as much as an eighth of an inch in thickness. In the one case the lymph resembles cream in consistence; in the other it resembles wash-leather; and between the two extremes we meet with all intermediate conditions as regards consistence and tenacity. Pus, granular corpuscles, oleo-protein granules, and epithelium constitute the bulk of the softer forms of the so-called lymph; while such fibres as we see in the buffy coat of blood-coagula constitute the bulk of the toughest variety of the lymphy pellicle (Jenner). Vegetable growths, as the *oïdium of muguet* (Vogel), occur in the pellicle of diphtheria from time to time, and have been reported by some as a constant occurrence. It is, however, by no means so; and the accidental existence of such vegetable growths is no evidence that epiphytes have any essential connection with cases of diphtheria (Jenner).

The lymphatic glands to which the lymphatics of the pharynx lead are found in cases of diphtheria to be larger, redder, and moister than natural; and if the disease has continued long, they become brittle, pale, and of a brightish red colour on section—characteristic of inflammation of their substance. These enlarged glands may be felt during life behind the angle of the lower jaw on either side, as well as down the neck by the sides of the larynx, when that organ is implicated. Such enlargement of the glands is just in proportion to the severity and depth of the local, nasal, pharyngeal, laryngeal, and tracheal disease; and when the discharges from the pharynx are fetid, and the mucous membrane sloughy, not only are the glands behind the angles of the jaw enlarged, but the connective tissue in which they are placed is the seat of the effusion of serum, and even the exudation of lymph, so that very great general swelling of the parts is the result.

Condition of the Urine in Diphtheria.—Albumen is found in many cases; 50 per cent. (LEE), 66 per cent. (BONCHUT, EMPIS), in the majority (MANGIN), in all the cases examined by the observer (SANDERSON). Its quantity appears to be sometimes enormous, so that the urine becomes quite solid from heat and nitric acid, (PARKES, l. c.)

Although it is not established that albuminuria is an essential element in the disease, yet it is a most important symptom, both as connected with the pathology of the disease and with its prognosis. The first discovery of the relation of albuminuria to diphtheria was made by Mr. Wade, of Birmingham, and was communicated to the Queen's College Medico-Chirurgical Society in December, 1857. During the following year Bonchut and Empis made a similar discovery in Paris. These observers attach very great importance to the renal complication, as affording an anatomical explanation of the fact that, in many cases of diphtheria in which death occurs neither by suffocation nor by septic poisoning, it cannot be due to local lesion. Bonchut considers it a sign of the commencement of purulent infection in diphtheria, and coincides with very great gravity of the disease. The blood then assumes the tinge of bistre; and numerous masses of pulmonary apoplexy may be found after death, resembling those which precede the development of metastatic abscesses in the lungs. Mr. Wade is of opinion that albuminuria produces a diminution in the total amount of solid excreta;—the special function of the kidney being suspended, symptoms arise which indicate the retention within the body of those matters which should be excreted.

Dr. Sanderson is of opinion that neither of these doctrines regarding the pathology of albuminuria in diphtheria is the true one. In several of the cases related by him the cessation of albuminuria was coincident with amelioration of the patient's condition and the disappearance of the most alarming symptoms. The early period of the disease at which the albumen appears, and the short time during which it lasts, are facts of great importance. Dr. Sanderson is of opinion that either (1.) the kidneys must be the seat of the primary morbid process; or, (2.) the albuminuria must depend on an

Urea increased ex.cn

original change in the blood. That it is not due to the former of these is evident from the fact that the renal disease is only coincident with disease elsewhere (*e. g.*, in the fauces), so that the special morbid condition of the blood induced by the *diphtheria miasm* must be regarded not only as the primary cause of albuminuria, but of all the other symptoms. This Dr. Sanderson illustrates by comparing the poison of diphtheria to that of the poison of cantharides, which, from the moment it enters the circulation, manifests its presence by albuminuria, and produces a series of anatomical changes in the kidney, which are identical with those described by Mr. Simon and Dr. Bristowe in diphtheria. Dr. Sanderson's observations still further show that, at the acmé of the disease, when the urine was intensely albuminous—when there was complete anorexia, and the ingesta reduced to a minimum—that then the quantity of urea excreted in twenty-four hours was about twice as great as that excreted during a similar period when convalescence was established—when the patient was eating, with an appetite, the ordinary hospital diet, with extras. Thus it is shown that diphtheria agrees with the other pyrexiæ in being attended with a marked increase in the excretion of urea, and that the existence in the kidney of the condition implied by albumen and fibrinous casts in the urine does not necessarily interfere with increase in the elimination of nitrogenous material. There is, therefore, no reason to apprehend the occurrence of uræmia as a consequence of the renal complication in diphtheria, this complication not being the cause of the blood-poisoning, but merely the index of its existence (*Brit. and For. Med.-Chir. Review*, Jan., 1860, p. 196).

Phenomena and Symptoms.—The *prodromata* which forebode an attack of diphtheria may be set down as general *malaise*, anorexia, slight fever, dysphagia, and glandular swelling. The symptoms generally supervene very gradually and insidiously; but feelings of depression, prostration, and muscular debility prevail, attended by headache, nausea, diarrhœa, and chilliness. There is a sense of stiffness about the neck and throat, and the drowsiness which often attends the accession of an attack of diphtheria may lead the patient to fancy he has caught a slight cold in the throat while indulging in a short sleep.

Dr. Jenner has grouped his cases of diphtheria into *six* varieties, as follows:—(1.) *The mild form of diphtheria;* (2.) *The inflammatory form;* (3.) *The insidious form;* (4.) *The nasal form;* (5.) *The primary laryngeal form;* (6.) *The asthenic form.*

(1) In *the mild form of diphtheria* the general symptoms and the local lesions are trifling, and no sequelæ follow. Febrile disturbance prevails to a slight degree; and there may be the least possible soreness of the throat on swallowing. No albumen occurs in the urine, and no nervous symptoms follow. Dr. Jenner is of opinion that many inflamed throats, when *diphtheria* is epidemic, have their origin in the *diphtheria miasm* (whatever that may be), just as many cases of *diarrhœa,* when *cholera* is epidemic, originate in the *cholera miasm;* and it is as difficult to say in some cases that an inflamed pharynx is not due to mild diphtheria as it is to say that a serious diarrhœa is not cholera.

(2) In *the inflammatory form of diphtheria,* symptoms of severe *cynanche pharyngea* precede the exudation of lymph. There is redness, of a vivid or dusky hue, and swelling of the mucous membrane, covering the arches of the palate, the uvula, and the tonsils. The swelling is often considerable, from the effusion of serum into the submucous tissue, which becomes of a jelly-like transparency and aspect. The pain in the act of swallowing is great, so that deglutition becomes impossible. The febrile disturbance may be extreme or moderate; and although the pulse is frequent, it soon becomes weak, and there is the sense of X. considerable prostration. In from twelve to forty-eight hours after the first symptoms of the throat affection supervene, a layer, more or less extensive, of tough lymph coats the inflamed surface, and death may follow from extension of the exudative process into the larnyx or trachea. The urine may contain albumen, and sometimes the joints are swollen, hot, and tender.

(3) The *insidious forms of diphtheria* are dangerous, because they seem sudden and unexpected. The general symptoms are not severe. There is no marked soreness of the throat, no notable swelling of the lymphatic glands; but suddenly laryngeal symptoms supervene, and death rapidly follows from suffocation; and the disease may be confounded with primary croup, if the pharynx has not been examined.

(4) In *the nasal form of diphtheria* a sanious discharge from the nose attracts attention, after some febrile disturbance of a low

type. The glands about the angle of the jaw begin to swell, the arches of the palate and tonsils become red and swollen, muco-purulent fluid bubbles in quantity from the narrowing isthmus of the fauces, and is apt to prevent the physician from seeing clearly the state of the pharyngeal mucous membrane. After a few days the disease may subside so completely as to leave its nature doubtful; but it may, on the other hand, spread to the larynx or the pharynx, when laryngeal or pharyngeal symptoms prevail, and the diagnosis is easy.

In *primary laryngeal diphtheria* the disease begins with painful deglutition, and is attended by redness and swelling of the mucous membrane of the pharynx, arches of the palate, uvula, and soft palate. Laryngeal symptoms rapidly supervene; and lymph may be seen on the arches of the palate, the exudation being more abundant at the base of the arch than above it, looking as if it spread from the larynx. Death threatens from *apnœa*.

In *the asthenic form of diphtheria* the patient dies from the constitutional effects of the general disease, which may begin with general and local symptoms of very moderate severity. The pulse, however, soon becomes rapid and feeble; the sense of weakness and of illness becomes extreme; the skin has a feverish pungency of heat to the touch; the complexion assumes a dirty-looking, pallid, and opaque aspect; and from an early period of the disease the tongue is brown, with *sordes* on the teeth. More or less lymph may be seen on the pharyngeal mucous membrane; and this lymph is of a granular, pulpy, or soft form. The patient may also swallow with perfect facility, and the throat symptoms may appear to be trivial in degree, even when the pharyngeal mucous membrane is covered with lymph. In some cases, however, the pain on swallowing is extreme. The exudative process may extend to the larynx, and this extension is indicated by a little huskiness and want of power in the voice, and imperfect laryngeal breathing. Death tends to supervene by asthenia about the tenth or twelfth day of the disease, preceded or not by delirium, which may commence at an early period of the disease.

There is no sharp line of distinction, however, between these several varieties of diphtheria.

The duration of cases of diphtheria varies from forty-eight

Bad Prognostic Signs
Extension to Larynx in 1st week
Exhaustion 2nd week
Vomiting
Hæm
Rapid weak pulse or very low
Delirium
Youth
22-4P

hours to fourteen days; and when the disease is fatal within a week, it is so by extension of the exudative process to the larynx. Laryngeal symptoms rarely commence after the expiration of the first week of the disease; and in more than half the fatal cases of diphtheria death results directly from disease of the larynx. When death occurs from asthenia the fatal result usually takes place about the second week of the disease. In the cases that are not fatal the specific disease terminates between the eighth and fourteenth day of the illness (JENNER).

Prognosis.—However mild a case of diphtheria may appear to be, no case is unattended with danger. The great danger during the first week is from extension of the exudative process to the larynx; and the least laryngeal quality in the respiration heard at the bedside is suggestive of danger. Subsequently to the first week death is to be apprehended from exhaustion and loss of nervous energy. An extremely rapid and feeble pulse is of grave import; and a very infrequent pulse is of fatal significance. Vomiting is another unfavourable symptom, especially if it should recur many days in succession. Hæmorrhages and albumen in the urine indicate blood change of great severity; and if the albumen is abundant, a fatal termination of the case may be expected. All the cases in which Dr. Jenner has known delirium to occur have ended fatally.

The danger in diphtheria seems to be in proportion to the youth of the patient. In the child, death is generally due to extension of the disease to the larynx;—after puberty it more often occurs from the general affection.

Sequelæ.—After the termination of the disease, symptoms of a very peculiar and characteristic kind are apt to supervene. The phenomena are referable to deranged innervation; and although their frequency and intensity is by no means invariably proportional to the severity of the primary disease, yet the more severe the case is, the more likely is nervous disorder to occur, and the more intense is it likely to prove. These consecutive phenomena do not appear at once. There is usually a brief period of convalescence between the disappearance of the primary and the appearance of the secondary phenomena of diphtheria. This period of temporary convalescence varies from a few days to a few weeks. The most alarming symptoms are referable to the heart. The frequency of its beats per minute begins to

Paralysis begins in fauces. extends
to eye, lips, tongue, arms & legs
Begins from 7th day to 4th week

Paralysis of heart
general symptoms

diminish, and a sense of languor supervenes, with tendency to vomiting. The heart's beats are found to be feeble, infrequent, and slow, and death supervenes from cessation of the heart's action (JENNER); or suddenly, from the deposition of fibrine within the heart, or in one of the great vessels (TANNER).

In other cases the paralysis is more widely spread, and the nervous symptoms more striking; although the nerve affections do not at once attain their maximum of intensity, but are progressive; and the progress of the paralysis, even in the same set of muscles, is seldom quite uniform. It is believed that the paralysis is due to a primary peripheral alteration of the nerves, which is propagated from the originally affected part to the spinal centre, much in the same way as in tetanus the irritation is transmitted from the wound (WEBER). If several sets of muscles are attacked, the faucial or pharyngeal are usually the first set to suffer; and the impairment of function is very early betrayed by the condition of the voice, and by the act of swallowing, with loss of sensibility of the *velum pendulum palati* (TROUSSEAU). The sight is subsequently apt to become impaired; then the muscles of the tongue, the lips, and those of the upper and lower extremity, become affected in the order named. In Dr. Greenhow's experience anæsthesia has co-existed with the paralytic affection of the fauces in all the cases. The mucous membrane over that region, naturally so sensitive, becomes altogether insensible and callous, even to repeated and forcible pricks with the nib of a pen; and in rare cases speech becomes so inarticulate as to be almost unintelligible. He has also observed that the paralysis and anæsthesia are sometimes more complete on that side of the fauces which was most severely affected in the early stage of the disease. When the pharyngeal muscles are paralyzed there is alarming difficulty in swallowing. The impairment of vision is probably due to paralysis of the ciliary muscle. It generally comes on suddenly, and is preceded for a day or two by dilatation and sluggish action, or actual paralysis of the iris. The tongue, lips, and cheeks may also become affected, both as regards motion and sensation. The parts then become numb or cold, or they experience a sense of formication or of scalding, and taste may be lost. The upper extremities are either first affected, or simultaneously with the lower. The power over the movements of the limbs becomes impaired, and

X WB
Can't
blow out
cheeks
say "a"

Anaesthesia accompanies the paralysis of all parts -

Hyperaesthesia occurs in calves, muscles of arms & soles of

anæsthesia is also more or less complete; or there may be tenderness with abnormal sensations, such as formication, and a perception of constriction or of tightness in the fleshy parts; or there may be convulsive movements of the limbs, resembling chorea. The earliest indications of these phenomena connected with the functions of the limbs are peripheral. Tingling is experienced at the tips of the fingers, accompanied with numbness, rendering the patient unable to pick up small objects. These phenomena then extend gradually to the wrist, and upwards to the elbows, and even to the shoulders; but the tingling and numbness is especially felt on the palmar surface of the hands. The limbs, when so affected, feel heavy, feeble, and cold. If the paralysis continues, the muscles concerned become flabby and emaciated, and strength becomes so much impaired that patients, who can move the affected limbs freely in bed, often walk with much difficulty, or are unable to stand unless supported. Increased sensibility of particular parts of the affected limbs accompanies the loss of power and general numbness, causing great distress, such as tenderness of the soles of the feet, the calves of the legs, or fleshy parts of the arms. There is also pain on pressure along the course of the principal nerves, such as the median nerve of the arm and the sciatic of the leg (*Edin. Med. Journal*, August, 1863). The duration of the paralysis varies greatly, but generally the cases eventually terminate favourably; the paralysis being only dangerous when it affects the respiratory muscles, and aggravates thereby an intercurrent pneumonia.

These phenomena of impaired nervous power generally betray themselves within three weeks from the date of convalescence; and the longest period at which Dr. Jenner has known death to occur after the first symptoms of diphtheria has been about two months.

Propagation of Diphtheria.—The disease seems to be infectious; and family constitution (rather than any anti-hygienic conditions) favours its development and determines its progress (JENNER, GREENHOW, SANDERSON).

Treatment.—So long as there is heat of skin and firmness of pulse the physician ought to abstain from alcoholic stimulants and rest contented by giving such saline medicines as exert a slight action on the skin and on the kidneys, or on both *Acetate of ammonia* and *citrate of potash* are well suited for this purpose. The bowels should be opened freely by a dose of *calomel* and *jalap;* or by *calomel* and *colocynth* pill, followed in the inflammatory or *sthenic* forms of the disease by a saline aperient—*e. g., sulphate of magnesia* in the *infusion of roses.*

The throat affection should be treated with warm fomentations externally, and by the inhalation of water vapour with acetic acid. A wine-glassful of vinegar to a pint of water is a good proportion (Jenner), and an inhaler should be used, as mentioned at page 343, under scarlet fever. Dr. Jenner recommends Squire's inhaler as the best. A lead gargle may be of service, composed of one fluid drachm of the solution of diacetate of lead in eight ounces of rose water; but gargles must not be persisted in if pain is caused by their use. The temperature of the room in which the patient is confined to bed ought to be kept at 68° Fahr., and its atmosphere made moist by the steam from a kettle with a long spout constantly boiling on the fire. If the patient can be enveloped in a warm moist atmosphere, so much the better; and this may be done by making a tent with blankets over the bed, and, by the aid of a spirit lamp, a tin kettle of boiling water may be maintained at the boiling point, and its steam thus made to envelop the patient.

If feebleness of pulse supervene, if the redness of the throat assume a dusky hue, if the sense of general weakness becomes extreme, wine in large doses frequently repeated is required. Six or eight ounces of port or sherry during the day for an adult may be given from the first, with as good a diet as the stomach can digest. During the course of the disease, much larger quantities of wine and even brandy may be necessary; but the quantity of stimulants must be regulated by the habits and age of the patients. A child of three years of age may take with advantage one or two drachms of brandy every hour—*i. e.,* from three to five ounces of brandy during the twenty-four hours (Jenner). Under all circumstances efficient daily action of the bowels must be secured, and the urinary and intestinal secretions should be examined daily.

If blood or albumen appear in the urine, diuretics are contra-indicated. Mustard poultices, warm lintseed-meal poultices, or the warm wet sheet, as recommended by Dr. Huss in typhoid fever, and referred to at page 423, may be applied to the loins under these circumstances. *Tincture of the perchloride of iron* has been recommended by Dr. Hislop, of Birmingham; and it may be advantageously combined with quinine in the following formula (TANNER):—

℞. Quinæ Sulphatis, gr. ii.; Acidi Hydrochlorici diluti, ♏x.; Tincturæ Ferri Perchloridi, ♏xv.; Infusi Calumbæ, ℥i.; *misce. Fiat haustus, omnibus sextis horis sumendus.*

Copaiva and cubebs are also highly spoken of by Frideau and by Trousseau.

With regard to topical applications, Dr. Jenner is of opinion that repeated applications to the throat of caustic solutions are injurious. He recommends one single but efficient application of a strong solution of nitrate of silver (℈i. to ʒi. of water), as a remedy which may stay the *spread* of the exudative inflammation; but that, on the whole, *hydrochloric acid* and water in equal parts will more frequently attain the object. It is especially the surface *round* the exudation, as well as the exudation itself, that should be painted well over with the solution, the brush being passed over the surface two or three times in quick succession. The white discoloration which results must not be confounded with the spread of the diphtheritic exudation. The discoloration from the acid passes away in about thirty-six hours; and that from the nitrate of silver somewhat quicker. *Medicinal carbolic acid* (as prepared by Calvert, of Manchester), is valuable as a gargle, in the proportion of 1 of acid to 200 parts of water.

There is considerable differences of opinion regarding the usefulness of topical applications, and the best means of applying them. *The tincture of the perchloride of iron* is recommended by some to be gently painted over the fauces. The local application of lime-water by frequent gargling or gentle brushing, with the internal administration of nitrate and carbonate of soda, prove speedily curative in the milder cases, and alleviate the more severe. Ice kept dissolving in the mouth is often also a great comfort in cases of diphtheria, of croup, and of all sore throats, and its use should never be omitted where it can be had. Dr. Greenhow remonstrates against the application of the more severe topical remedies. The pellicle or false membrane ought never to be torn off. In the consecutive paralysis tonics and local galvanism are the most important remedies, and the bowels should be kept open by a pill, taken morning and evening, con-

Lactic acid 15 – 30 p Aq – ℥ 1, by Atomiser
McKenzie

taining from *a quarter to a half-a-grain of the extract of nux vomica, with a like quantity of sulphate of iron, combined with two or three grains of compound rhubarb pill mass.* These may be varied with the administration of pills containing $\frac{1}{12}$th *of a grain of strychnia*, the *strychnia* being triturated with *sugar of milk*, and made into pills with a sufficient quantity of extract of gentian. *Syrup of the phosphate of iron* in fluid drachm doses may be given twice a day, and stimulants in the form of malt liquors, especially stout (if free of *cocculus indicus*), are beneficial if taken with or after meals, and the doses of iron may be taken at the same time.

Tracheotomy undoubtedly saves a small proportion of cases. It ought to be had recourse to if the exudative inflammation extends to the larynx and advances in severity. The degree and increase of the recession of the soft parts of the parietes of the chest during inspiration is the guide to its necessity. In the adult, laryngotomy is to be preferred to tracheotomy. Dr. Jenner is of opinion that the opening should be made even through the seat of disease, and not below it; for, in opening through a healthy part, a new centre of irritation and inflammation is established. The sole object contemplated by an opening in the windpipe is the prevention of death by suffocation. By so averting death, time is gained for the general disease to run its course (JENNER).

CROUP.

LATIN, *Angina trachealis;* FRENCH, *Croup;* GERMAN, *Croup*—Syn., *Häutige Bräune;* ITALIAN, *Laringitide membranacea.*

Definition.—*A specific disease, accompanied by the exudation of an albuminous material upon the mucous membrane of the epiglottis, glottis, larynx, or trachea, and sometimes over all of these parts, indicated by accelerated, difficult, wheezing, or shrill respiration; short, dry, constant, barking cough; voice altered by hoarseness, with spasm of the interior laryngeal muscles, and pain and constriction above the sternum; frequently followed towards the close of the disease by expectoration of a membranous albuminous substance, or even of a cylindrical cast of some portion of the breathing tube. The disease occurs in children, and may terminate fatally either in suffocation or exhaustion of the vital powers.*

Pathology and History.—It has often excited much surprise that a disease so distinctly marked in its symptoms should not have been accurately described before the middle of the eighteenth century, when Dr. Francis Home published a treatise on the *suffocatio stridula* or *croup,* in 1765, as it was observed in Leith, Musselburgh, and the vicinity of Edinburgh. It has been described under the name of *cynanche trachealis;* and Dr. Farr has proposed for it the name of "*trachealia*" in scientific nosological nomenclature.

Before the time of Dr. Home, however, there is reason to believe that the disease was confounded with other affections of the throat and breast resulting simply from exposure to cold. It was certainly also described and distinguished by Martin Shisi, in 1749, at Cremona, and by Starr, of Liskeard, in Cornwall, in the same year (*Phil. Trans.,* 1750). Many physicians have described the disease since that time, and none with more minuteness than Dr. Cheyne, of Leith, who observed it for several years, and illustrated its pathology by careful dissections.

The most remarkable pathological phenomena of croup are to be observed in the exudative process which attends the inflammation in the windpipe, and the formation of a false membrane, almost peculiar to children, but sometimes seen in adults. When death takes place after an illness of four or five days, the windpipe is found to be lined with a white or grey substance. The membranes thus formed vary much in thickness and consistency. Some are so thin that the mucous membrane is readily seen through them, while others are many lines in thickness, exceeding even that of the mucous membrane itself, and consequently opaque. With respect to their consistency, some are so little coherent that they are almost diffluent, while others can be detached for a considerable extent without rupturing. The false membrane, though occasionally only partial, yet more commonly embraces the entire circumference of the larynx, forming a complete hollow cylinder adapted to the walls of the larynx. The membrane is in most instances limited to the larynx, but in some cases it extends down the trachea to the bifurcation, while in a very few cases it reaches even to the minutest branches of the bronchi. M. Hussenot says, of 120 cases he examined in 1778, it did not extend beyond the larynx, while in 42 cases it invaded the trachea or bronchi. The membrane thus formed is in a few instances removed by the cough, but more generally it adheres with so great tenacity that it can only be detached by a thinner and more serous secretion taking place from the mucous membrane beneath it, which loosens and displaces it. The extent of the exudation, as indicated by the surface covered, is perhaps the most interesting and practically useful part of the pathology of the disease. The place first and most particularly affected is the upper part of the *trachea*, about an inch below the *glottis*. In that part patients complain of a dull pain. External swelling has been observed there; and the morbid membrane is found spreading from that place downwards. The back part of the trachea, where there are no cartilages, seems to be its first and principal seat (HOME). According to Guersent, false membrane is never entirely absent from the larynx. Sometimes it is confined to the glottis, and sometimes lines the whole interior of the larynx, including the ventricles; and not unfrequently it extends throughout the trachea, and, for a greater or less distance, into the bronchial tubes. Dr. Wood instances a case in which he saw the false membrane line the upper portion of the bronchia, the whole trachea and larynx, and the pharynx as low down as the œsophagus. More frequently, he says, the exudation is in the form of patches, or long narrow ribbons, and occasionally, in the earlier stages, it has a granular aspect, with the red mucous membrane appearing in the intervals of the imperfectly connected patches. According to Cheyne, in none of the cases recorded by him was membranous exudation observed in the laryngeal mucous membrane; and if the inflammation extended to this part, it was only slight, and its effects were seen in a little puriform fluid in the membrane of the circoid or thyroid cartilages. Some state that it is essential to the constitution of croup that the larynx should be more or less involved in inflammation, or high vascular irritation, accompanied with spasms of the internal muscles of the larynx (WOOD). Others say that the inflammation in croup is truly tracheal, and even bronchial (CRAIGIE, COPLAND). In the more acutely inflammatory form it may extend to the larynx and epiglottis, in some cases; in others, to the first ramifications of the bronchi; and sometimes in both directions (COPLAND).

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Dr. Copland, who has paid particular attention to the pathology of croup, states the following as general inferences from his observations:—"(*a.*) That the mucous membrane itself is the seat of the inflammation of croup; and that its vessels exude the albuminous or characteristic discharge, which, from its plasticity and the effects of temperature and the continued passage of air over it, becomes concreted into a false membrane;—(*b.*) That the occasional appearance of blood-vessels in it arises from the presence of red globules in the fluid when first exuded from the inflamed vessels, as may be ascertained by the administration, upon the approach of the symptoms, of a powerful emetic, which will bring away this fluid before it has concreted into a membrane; these globules generally attracting each other, and appearing like blood-vessels, as the albuminous matter coagulates on the inflamed surface;—(*c.*) That the membranous substance is detached in the advanced stages of the disease, by the secretion from the excited mucous follicles, of a more fluid and a less coagulable matter, which is poured out between it and the mucous coat; and, as this secretion of the mucous *cryptæ* becomes more and more copious, the albuminous membrane is the more fully separated, and ultimately excreted if the vital powers of the respiratory organ and of the system be sufficient to accomplish it;—(*d.*) That subacute or slight inflammatory action may be inferred as having existed, in connection with an increased proportion of fibro-albuminous matter in the blood, whenever we find the croupal productions in the air-passages; but that these are not the only morbid conditions constituting the disease;—(*e.*) That in conjunction with the foregoing—sometimes only with the former of these in a slight degree—there is always present, chiefly in the developed and advanced stages, much spasmodic action of the muscles of the larnyx, and of the transverse fibres of the membranous part of the trachea, which, whilst it tends to loosen the attachment of the false membrane, diminishes, or momentarily shuts, the canal (of the larynx) through which the air presses into the lungs;—(*f.*) That inflammatory action may exist in the trachea, and the exudation of albuminous matter may be going on for a considerable time before they are suspected—the accession of the spasmodic symptoms being often the first intimation of the disease; and these, with the effects of the pre-existing inflammation, give rise to the phenomena characterizing the sudden seizure;—(*g.*) That the modifications of croup may be referred to the varying degree and activity of the inflammatory action, the quantity, the fluidity, or plasticity of the exuded matter, the severity of spasmodic action, and to the predominance of either of these over the others in particular cases, owing to the habit of body, temperament, and treatment of the patient, &c.;—(*h.*) That the muco-purulent secretion, which often accompanies or follows the detachment and discharge of the concrete or membranous matters, is the product of the consecutively excited and slightly inflamed state of the mucous follicles, the secretion of which acts so beneficially in detaching the false membrane;—(*i.*) That a fatal issue is not caused merely by the quantity of the croupal productions accumulated in the larynx and trachea, but by the spasm, and the necessary results of interrupted respiration and circulation through the lungs;—(*k.*) That the partial detachment of fragments of membrane, particularly when they become entangled in the larynx, may excite severe, dangerous, or even fatal spasm of this part, according to its intensity relatively to the vital powers of the patient; and that this occurrence is most to be apprehended in the complicated states of the malady where the inflammatory action, with its characteristic exudation, spreads from the fauces and pharynx to the larynx and trachea, the larynx being often chiefly affected in such cases, and from its irritability and conformation giving rise to a more spasmodic and dangerous form of the disease;—(*l.*) That the danger attending the complications of croup is to be ascribed not only to this circumstance, but also to the depression of vital power, and the characteristic state of fever accompanying most of them, particularly in their advanced stages;—(*m.*) That irritation from partially detached membranous exudations in the pharynx, or in the vicinity of the larynx or epiglottis, may produce croupal symptoms in weak, exhausted, or nervous children, without the larynx or trachea being themselves materially diseased; and that even the sympathetic irritation of teething may occasion the spasmodic form of croup, without much inflammatory irritation of the air-passages, particularly when the *primæ viæ* is disordered, and the membranes about the base of the brain are in an excited state;—(*n.*) That the predominance in particular cases of some one of the pathological states noticed above (*g.*) as constituting the disease, and giving rise to the various modifications it presents, from the most inflammatory to the most spasmodic, may be manifested in the same case, at different stages of the malady, particularly in its simple forms, and in the relapses which may subsequently take place; the inflammatory character predominating in the early stages, and either the mucous or the spasmodic, or an association of both, in the subsequent periods;—(*o.*) That the relapses, which so frequently occur after intervals of various duration, and which sometimes amount to seven or eight, or are even still more numerous, may each present different states or forms of the disease from the others; the first attack being generally the most inflammatory and severe, and the relapses of a slighter and more spasmodic kind; but in some cases this order is not observed, the second or third, or some subsequent seizure, being more severe than the rest, or even fatal, either from the inflammation and extent of exudation, or from the intensity and persistence of the spasmodic symptoms,—most frequently from this latter circumstance. The above inferences, however minute or trite they may seem, should not be overlooked, as they furnish the safest and most successful indications of cure, and are the beacons by which we are to be guided in the treatment of the disease."

The name of *croup*, by which this disease has hitherto been known in this country, is of Scottish origin. Cullen's *cynanche trachealis,* and the more modern *tracheitis,* are objectionable terms, because they lead to false notions of the pathology of the disease. The "choak," "stuffing," "rising of the lights," and "hives," are all designations by which the disease has been described, and some of them are still names in vogue amongst the common people of the country.

The disease is almost peculiar to infancy and childhood; and there are two forms which can generally easily be distinguished from each other, but which are often confounded. One form is very manageable, the other very fatal. In the former variety the mucous membrane chiefly secretes mucus, pus, or muco-purulent fluid. In the more dangerous form an albuminous, fibrinous, or mucinous exudation grows upon the inner surface of the air-passages, constituting the false membranes already described. The first form seems to be the one common in America, of which not more than *one* in *fifty* dies. The latter is the more common European form, of which the deaths used to be *four* out of *five,* and still are about *a half.* About one child in twelve deaths of children dies from this disease; and the ratio borne by croup to 1,000 deaths from all causes, in 1854, was as 9·249.

Symptoms and Course.—The mildest form of croup differs from an ordinary catarrh only in the addition of spasmodic symptoms; but this form may run into the more severe form, so that it is not possible to determine, in the first instance, which form the disease may ultimately assume.

The catarrhal croup of Dr. Wood embraces the spasmodic as well as the catarrhal croup of Dr. Copland. Spasmodic action of the laryngeal muscles is, however, common to both, and is characteristic; but the inflammation and exudation is not in general more severe than that which attends a common catarrh.

The disease may be ushered in by sore throat, by catarrhal symptoms, or by a short dry cough; or it may occur *per se*, and without the general health being sensibly impaired. In either case the attack commonly takes place during the night, the sleep of the child, which was perhaps more or less agitated, being interrupted by fits of *hoarse* coughing. These become more frequent, the respiration more difficult, and marked by a peculiar wheezing, which has been described as like the sound of an inspiration forcibly made with a piece of muslin before the mouth, or like to the sound of air passing through a brazen tube. The little patient also feels a sense of restriction about the throat, as shown by carrying the hand often to it, and grasping the larynx. After the paroxysm has lasted some hours, there is an interval of ease, which perhaps lasts for some hours.

By the end of the second or third day, sometimes sooner, the tongue becomes white, the heat of the body increased, the pulse frequent, the face flushed, and the countenance distressed. From this point the disease now rapidly advances, the croupy sound attains its height, and Dr. Home describes it as "*vox instar cantus galli;*" others have compared it to the noise which a fowl makes when caught in the hand; while the child often puts its fingers into its mouth, as if to pull away something which obstructs the passage.

As the disease draws towards a close the paroxysms become more frequent, the cough more severe, the pulse more rapid, suffocation more imminent, and the extremities cold and livid. The final close of the disease is often by convulsions, sometimes almost tetanic; and Dr. Ferrier once was present when the struggle was so violent that after death the corpse, in a great measure, rested on the occiput and on the heels.

Often, however, the symptoms are much more moderate; although it not unfrequently happens that symptoms of the severer form come on, indicated by a huskiness of the voice, till no sound can be heard above a whisper, by a muffled cough, and a wheezing noise which attends the inspirations. It is seldom that children expectorate; but in happier cases than the above, mucus, tinged perhaps with blood, is coughed up, and later, perchance, the false membrane is detached and thrown up, and the patient recovers.

The croup which has been described is of the most acute kind; but in many cases its course is much more chronic, the symptoms generally milder, and the intervals of ease longer and more complete, during which the breath is free, the child cheerful, and the appetite good. In the course of a few days, however, a violent paroxysm seizes the child, and destroys him with every appearance of one strangled.

According to Barth, on the stethoscope being applied to the larynx, we hear a sort of "*tremblotement*," as if a moveable membrane was agitated by the air; and he considers this phenomenon as an unerring evidence of the existence of a false membrane in the larynx. Laryngitis in the adult is marked by the same difficulty of breathing, the same lividity of countenance, the same constriction of the throat, the same paroxysmal attack, and by the same exemption from any severe constitutional affection. The voice, however, instead of being sharp and shrill, is generally deep and hoarse, although sometimes altogether lost—differences depending perhaps on the greater size of the glottis, and on the fact of the parts being the seat of ulceration rather than of the effusion of lymph. At length the patient is cut off in one of the paroxysms. The duration of this disease, when acute, is short. The celebrated Dr. Pitcairn died on the fourth day from the first attack, and Sir John Hay, Physician to the Forces, died within the same period. More commonly, perhaps, the disease passes into a chronic state, when the patient may survive many weeks, or even months. Several cases are on record of croup having terminated in twenty-four hours; more frequently, however, the child lives to the third or fourth day, and in

Duration 1 d — 1 or 2 wks
Mortality 4 in 5 or ½
Period of life 1 – 7 yrs
Death Apnœa.

Boys more liable than girls

chronic cases much longer. From one day to one or two weeks may be given as the variable periods of the duration of this disease.

Diagnosis.—It is generally between croup and the following diseases:—namely, the different forms of sore throat, as in *scarlet fever* and *measles*, *diphtheria*, *bronchitis*, *chronic laryngeal and tracheal inflammation*, and *hooping-cough;* and the differential symptoms of each of these from croup must be studied by comparing the definitions, symptoms, and course of each of these diseases, as well as the epidemic constitution as regards *scarlet fever*, *measles*, *diphtheria*, and *hooping-cough*.

Modes of Propagation.—Croup is said to be more frequent in cold and moist climates than in those which are warmer. It is also much more severe in Europe than in America; and its existence and progress is considerably influenced by changes of season, weather, and temperature. It is prevalent in Switzerland and Savoy, in the eastern counties of England and Scotland, the north-west countries of Europe, and in the northern parts of America. While the annals of medicine are rich in descriptions of epidemic and endemic croup, opinions are very much divided as to the nature of the epidemic influence, and whether or not the disease is contagious or infectious.

Age has, perhaps, the greatest influence in predisposing to the disease, and, while rare in adults, it is seldom seen in early infancy. It is most prevalent between the *first* and *seventh* years of life. According to the experience of Dr. Wood, the disease appears to run in families; and vigorous fleshy children, with rosy complexions, are frequently those who suffer most.

Prognosis—"Is never better than doubtful." It is to be determined from the violence of the local symptoms, and the frequency of the paroxysms, rather than from the constitutional symptoms. Children, however, seized with croup are said to recover in a smaller proportion in this country than in America. Death tends to occur by *apnœa*.

Treatment.—*Every case of croup demands the most active, efficient, and energetic treatment.* When the croup in children commences in the larynx, its course is so rapid and so fatal that the measures for its suppression must be early. Bleeding, and especially local bleeding, should be employed, and in most cases to a considerable extent (an ounce of blood for every year of

CuSO4 x – xv gr
Aq ℥iv
A large teaspoonful
every 5 minutes
till vomiting sets in
Niemeyer
vol 1. 27

℞ Pulv. Ipecac gr IV – VI
Ant. Tartarate gr 1/3 – 1/4
ft. Emetic

age);—and two to twelve leeches, according to the age of the patient, should be applied over the larynx. After these have fallen off, the bleeding should be encouraged by the application of a lintseed poultice to the throat. This first bleeding often gives great relief, and sometimes averts the disease; but if not, the leeches, after a few hours, may be repeated. As soon as some relief is obtained, a blister should be applied along the lateral aspect of the neck on each side, and not over the trachea; and after that is removed, the part should be dressed with strong mercurial ointment. In addition to bleeding and blistering, many practitioners prescribe *emetics;* first, because their emetic effects, and the large evacuations they produce, favour the resolution of the inflammation; and again, because the effort of vomiting may be the means of detaching and of expelling the false membrane, should it have formed. If relief does not ensue on the action of the emetic, Dr. Cheyne recommends *two, three,* or *four* grains of calomel, with *two* or *three* grains of James's powder, to be given at short intervals every two or three hours; and a dose of castor oil is to be given occasionally till the full effect of the calomel as a purgative is obtained. Green fæcal stools, like chopped spinach, are characteristic of this result.

Bleeding, blistering, and mercury, although the rule of treatment in idiopathic infantine croup, are, for the most part, entirely inefficient in those cases in which the affection begins in the fauces, as in the case of many epidemics, and especially after scarlatina. In these cases the best treatment, if the false membrane be not already formed, is to relieve the throat by the application of a few leeches, as in scarlet fever, and then to support the little patient with a moderate quantity of wine diluted with water. If the false membrane has formed, perhaps an emetic affords the only chance of relieving the patient; and, indeed, so soon as croupy cough and dyspnœa occur, an emetic of *ipecacuanha* with *tartar emetic* ought at once to be given in doses suited to age. Four to six grains of ipecacuanha, combined with a quarter or a third of a grain of tartar emetic, will be found sufficient for a child of two or three years of age. The action of the emetic may be aided, with benefit, by a warm bath of 98° to 100° Fahr. in temperature. If it becomes obvious that the exudation has assumed the form of a membrane, especially if indicated by a diphtheritic coating over the fauces, a solution of the nitrate of silver, varying in strength from forty to one hundred and twenty grains to the fluid ounce of distilled water, should be applied to as much of the fauces and larynx as can be reached. A sponge on the end of a piece of whalebone, as sold ready made by the instrument makers, should be loaded with the weaker solution, and squeezed against the *rima glottidis* two or three times a day. Bleeding has no effect in removing or modifying the false membrane; but the system must be brought as speedily as possible under the influence of mercury. Mercury appears a powerful resource in these cases; and, introduced either internally or by inunction, so as to affect the mouth, but without inducing salivation, uniformly gives relief as soon as the constitutional affection is established. However, the amelioration is too often transitory. NB

Expectorant medicines should be given with the mercurials, and be continued after them. *Ipecacuanha* and *seneka* have the most efficient influence over the mucous membrane. Five-grain doses of *iodide of potassium* every two hours, and of *chlorate of potassa* have been used with benefit; and the use of a vapour bath from 75° to 80° Fahr. is not to be neglected (Budd). Vide Tanner

The medical treatment of croup is so frequently unsuccessful that tracheotomy has often been had recourse to as the means of prolonging life, and, consequently, as affording an additional chance of the patient's recovery. Guersent has performed this operation repeatedly at the Hôpital des Enfans, but almost always without success. On the other hand, M. Trousseau states that he has saved one-third of his patients by its means; and of twenty cases Bretonneau saved six. Perhaps the experience of the profession, generally, is equally discordant on this point at this moment; for those who operate early contend they save some portion of their patients, while those who wait till a case is advanced, and beyond medical treatment, before they resort to this measure, for the most part lose all their patients. The evidence, however, is daily accumulating which shows that tracheotomy ought to be resorted to much oftener, as a remedy for croup, than it has hitherto been, and that *at a much earlier period in the disease,—not as a last resource, when death from asphyxia appears imminent, and after treatment of the most depressing kind.* That this is the secret of success in France and in this NB

If exp as well as insp ~~are~~ is impeded there are false membranes in the larynx obstructing it - give an emetic at once (Niemeyer)

Insp only affected means muscles of larynx paralysed by oedema

country is shown by the experience of able physicians and good surgeons, of whom the names of M. Trousseau, the late Mr. Jones, of Jersey, Mr. Henry Smith and Dr. Fuller, of London, the late Dr. Cruickshank, of Dalmellington, in Scotland, and Mr. Spence, Professor of Surgery in the University of Edinburgh, Dr. George Buchanan, in Glasgow, and Professor Roser, of Tübingen, may be stated as authorities by experience. In country districts the performance of tracheotomy in a case of croup is almost imperatively called for in the majority of cases, *if some symptoms of amelioration do not follow the steady use of bleeding, emetics, the warm bath, and calomel purgation, pursued for twelve or sixteen hours.* I know that, in a wild country district of Scotland, where croup was very common and fatal, the late Dr. Cruickshank saved eight out of eleven cases during two years. A valuable paper by Mr. Smith, in *The Medical Times and Gazette*, 26th January, 1856; another by the late Mr. Jones, of Jersey, in the 8th November of that year; and, lastly, a paper by Dr. Conway Evans, in the *Edinburgh Medical Journal* for January and May, 1860, go to support the same conclusion,—namely, that an earlier introduction of air, by the operation of tracheotomy, for croup, would not only give a larger per centage of recoveries in this country, but would place the operation in the same favourable light in which it is now regarded in Paris and other parts of France. Tracheotomy in croup is undoubtedly gaining ground; and it cannot be denied that children perish in the first instance almost always from suffocation. Tracheotomy is therefore indicated in croup (as in diphtheria) as soon as there are urgent symptoms of obstruction of the glottis. When the respiration is so impeded that the demand for oxygen is only satisfied by difficult forced respirations, dreadful anguish is depicted on the reddened countenance covered with sweat; there is extreme restlessness; the patient tosses from side to side, gets out of bed one minute and into it the next, clutching spasmodically at those around him, as if seeking everywhere for help. NB *This is the proper period for the operation of tracheotomy in croup,*—the time when success may be expected (Roser). Should the operation be longer delayed, symptoms of asphyxia appear, overloading of the blood with carbon ensues, the face suddenly becomes blue, with fixed and staring eyes, convulsive exertions are made, and anxious struggles for breath follow the stage of suffocative agony.

Use cold compresses to throat
Sponge larynx with Ag No3 3p to Aq 3ij
Keep pt in bed in warm & moist atmosphere
Give Calomel ½ gr 2 to 3 hours

If attacks [illegible] & Dyspnoea increase Tracheotomy
(Emergency)

In some cases the symptoms of asphyxia come on more slowly, and are apt to make considerable progress before the danger is fully appreciated. This insidious form of asphyxia is denoted by symptoms of great weariness and weakness, restlessness, oppression, anxious startings out of short slumbers, loss of consciousness and of feeling, approaching stupor, the face pale, and tending to become œdematous. If tracheotomy is delayed till these symptoms become expressed, it may still enable the child to breathe more freely, and thereby may promote the chances of recovery; but the child has usually no longer power to resist the advancing bronchitis. The causes of death after the operation are mainly pneumonia, bronchitis, or the severity of the constitutional febrile state (*Syden. Society Year-Book*, 1863, p. 278). Abscesses in the anterior mediastinum, pleuro-pneumonia, and pericarditis have been found after death. The fatal result, therefore, seems in some cases to depend on a cause acting generally on the system, and which ultimately destroys the patient. This cause gives a difference of type to the disease in this country from what it has in France; but as this difference appears, in the first instance, to be aggravated by the obstruction to the passage of air, there is thus a still more powerful reason why the operation of tracheotomy ought to be resorted to early. Age also seems to influence success to a considerable extent. Under *two* years of age few cases recover; but between the ages of *six* and *twelve* nearly one-half are saved (CONWAY EVANS).

To relieve paralytic symptoms due to Noxious Poisons
blood poisoning by Co put pt into a warm
bath & pour cold water over head & back

DYSENTERY.

LATIN, *Dysenteria;* FRENCH, *Dysenterie;* GERMAN, *Ruhr*—Syn., *Dysenterie;* ITALIAN, *Dissenteria.*

Definition.—*A specific febrile disease, accompanied by tormina, followed by straining, and scanty mucous or bloody stools, which contain little or no fæcal matter. The minute lenticular and tubular glands of the mucous membrane of the large intestines, with the intertubular connective tissue, are the chief seats of the local lesion, which sometimes extends into the small intestine beyond the ileo-colic valve; as in cases in which* scorbutus *is a predisposing cause.*

Historical Notice, Pathology, and Morbid Anatomy.—Dysentery is a disease which varies considerably in different countries and localities; and sometimes in apparent accordance with the exciting cause. Sporadic cases, which now and then occur in our large towns, are not generally so violent, and are less fatal than the epidemic cases, and those which occur in tropical climates. The effects on the constitution are no less varied and severe.

Dysentery has at all times proved one of the most severe scourges of our fleets on foreign stations, of our armies in the field, and during campaigns, even in temperate regions. It is sometimes so prevalent that it exceeds the number of sick from all other diseases put together. It has followed the tracks of all the great armies which have traversed Europe during the Continental wars of the past 200 years. It helped to destroy the British army in Holland in 1748. It decimated the French, Prussian, and Austrian armies in 1792. It was a chief cause of death in the ill-fated Walcheren expedition in 1809. It cut down the garrison of Mantua in 1811 and 1812. Sir James M'Grigor records how fatal the disease was in the Peninsular campaigns; and we know how disastrous it was to our troops during the first winter they passed in the Crimea, in 1854. In the words of Sir Ranald Martin, "It is the disease of the famished garrisons of besieged towns, of barren encampments, and of fleets navigating tropical seas, where fruits and vegetables cannot be procured. During the Peninsular war, the first Burmese war, and the late war with Russia, *dysentery* was one of the most prevalent and fatal diseases which reduced the strength of the armies." German army Metz Octr 1870

That it is a dangerous and frequent disease throughout our intertropical possessions, the tabular statements on the next page, furnished by Sir Alexander Tulloch to Sir Ranald Martin, and by Dr. Joseph Ewart, of Calcutta, sufficiently testify.

In England generally, however, *dysentery*, as a cause of death, has been decreasing since 1852, although about 200 years ago it was one of the most prevalent and fatal diseases of London. Yet still, although the disease is less violent and less fatal (for as a cause of *death* it has remarkably diminished during the past ten or twelve years), and although the unfavourable hygienic conditions which were wont to bring about dysentery no longer exist, the active endemic conditions which favour, promote, or are congenial to its development are only dormant, and not eradicated. The disease, therefore, is still sometimes brought

PREVALENCE AND MORTALITY OF DYSENTERY IN VARIOUS COUNTRIES, BY THE LATE SIR ALEXANDER TULLOCH, K.C.B.

STATIONS.	Period of Observation	Aggregate Strength.	DYSENTERY.		
			Attacked.	Died.	Proportion of Deaths to Admissions.
Windward and Leeward command,...	20 years.	86,661	17,843	1,367	7·7 per cent.
Jamaica,......	20 ,,	51,567	4,909	184	3·7 ,,
Gibraltar,......	19 ,,	60,269	2,653	64	2·4 ,,
Malta,......	20 ,,	40,826	1,401	94	6·6 ,,
Ionian Islands,......	20 ,,	70,293	3,768	184	4·8 ,,
Bermudas,......	20 ,,	11,721	1,751	36	2·0 ,,
Nova Scotia and New Brunswick,	20 ,,	46,442	244	18	7·4 ,,
Canada,......	20 ,,	64,280	735	36	4·8 ,,
Western Africa,......	18 ,,	1,843	370	55	14·2 ,,
Cape of Good Hope,...	19 ,,	227,111	1,425	44	3·0 ,,
St. Helena,......	9 ,,	8,973	751	69	9·0 ,,
Mauritius,......	19 ,,	30,515	5,420	285	5·2 ,,
Ceylon,......	20 ,,	42,978	9,069	993	11·1 ,,
Tenasserim Provinces,	10 ,,	6,818	1,460	137	9·3 ,,
Madras,......	5 ,,	31,627	6,639	559	8·3 ,,
Bengal,......	5 ,,	38,136	5,152	411	8·0 ,,
Bombay,......	5 ,,	17,612	1,879	151	8·0 ,,

AVERAGE RATES OF SICKNESS AND MORTALITY FROM DYSENTERY AND DIARRHŒA AMONG EUROPEAN TROOPS IN INDIA. (Compiled from data contained in Tables XXVI. and XXVII. of *Vital Statistics of European and Native Armies in India*, by Dr. Joseph Ewart, of Calcutta Medical College.

Presidency.	Periods.	Strength.	Admissions.	Deaths.	Per centage of Admissions to Strength.	Per centage of Deaths to Strength.	Per centage of Deaths to Admissions.
I.—FROM DYSENTERY ALONE.							
Bengal,......	1812 to 1853-4	543,768	100,542	8,873	18·48	1·64	8·82
Bombay,......	1803-4 to 1853-4	306,978	51,010	4,705	16·61	1·53	9·22
Madras,......	1829 to 1851-2*	213,587	30,593	2,304	14·32	1·07	7·53
II.—FROM DIARRHŒA.							
Bengal,......	1812 to 1853-4	543,768	64,823	2,141	11·92	·39	3·30
Bombay,......	1803-4 to 1853-4	306,978	32,290	551	10·51	·17	1·77
Madras,......	1829 to 1851-2*	213,587	19,458	353	9·11	·16	1·81
III.—FROM DYSENTERY AND DIARRHŒA—AS A CLASS.							
Bengal,......	1812 to 1853-4	543,768	165,365	11,013	30·41	2·02	6·65
Bombay......	1803-4 to 1853-4	306,978	83,300	5,256	27·13	1·71	6·30
Madras,......	1829 to 1851-2*	213,587	50,051	2,657	23·43	1·24	5·30

* Exclusive of 1839, 1840, and 1841.

about just as in the days of Sydenham or Willis. In no respect, however, do we find that the dysentery of this time differs essentially from the description given by Sydenham more than a hundred and thirty years ago. When we look, therefore, to the history of the disease, and to the nature of its lesions—to its re-appearance from time to time among us, with the same identical characters—there are strong grounds for believing that there is something specific in the nature of the poison which produces dysentry, just as specific as that of *small-pox*, *typhus fever*, *typhoid fever*, *yellow fever*, *scarlatina*, *ague*, or *diphtheria*. But besides the specific identity of the disease, as it now exists, with the disease of former times, there is another point of view from which the history of the pathology of dysentery is especially instructive. It is this:—Like all diseases which have been at the same time epidemic and severe, it has been the subject of discussions as frequent and as varied as its ravages have been severe; and one single description of the disease will not do for a record of the characteristics of all epidemics. Most minute descriptions of the state of the intestines in dysentery have been given by many writers; but, as Dr. Copland justly observes, from his extensive experience, "Dysentery is neither so simple in its nature, nor so unvarying in its seat and form, as some recent writers in this country have stated;" and "that writer will but imperfectly perform his duty who, in giving a history of a most prevalent and dangerous malady, confines himself to the particular form it has assumed during a few seasons, within the single locality, or the small circle of which he is the centre, and argues that it is always as he has observed it."

Dysentery is, moreover, a most formidable disease, on account of its oftentimes insidious nature, from its tendency to recur, and from the after-influences it exerts on particular organs and on the system at large. For these reasons almost all writers on the diseases prevalent in tropical climates place dysentery at the top of the list of severe affections, and refer to it as the cause and origin of many of those chronic and intractable abdominal diseases which so often afflict Europeans resident in tropical climates; and which entails most varied forms of impaired health when they return to European climates.

The morbid anatomy of dysentery has not been described with uniform distinctness, and the anatomical descriptions have, in general, been extremely vague. Medical science has not yet finally settled many points in the pathology of the disease; consequently, the doctrines as to treatment are somewhat uncertain; while the means of prevention are not less imperfectly defined. It has been usual to describe cases of *dysentery* as being either *acute* or *chronic;* but there are also cases belonging to a third class, which may be termed *complex.*

Acute Cases of Dysentery.—In this form the specific lesion in the form of inflammatory action does not confine itself to the tissues of the mucous membrane only. The serous covering of the intestine, or even such solid viscera as the liver, spleen, kidneys, are involved in a disease-process. Ulceration or sloughing of large portions of mucous membrane and exudation go on together, and there may be very little corresponding fever at all commensurate with the severity of the lesions, so that while the disease is acute, it is at the same time, in many instances, of a masked and almost latent nature. Death frequently takes place within the first ten or twelve days in such cases; but the disease may terminate gradually and spontaneously, or as the result of appropriate treatment, by the end of the third or fourth week. On the other hand, the disease may not end so favourably and early; but, evincing a marked and obvious resistance to treatment, may advance unchecked; the morbid changes being slow in progress, often extending over several months, and then the case passes into

Chronic Dysentery—One of the most hopeless and intractable forms of disease which the physician has to treat. Under the influence of the slow morbid changes about to be noticed, the wasting of the tissues of the patient progresses steadily, till a human form, literally reduced to the state of a living skeleton, whose bones are held together by skin and ligament, is all that remains. The skin acquires a dry, bran-like, furfuraceous aspect, and the epithelium desquamates in scales and powdery particles. During the progress of such chronic cases various intercurrent morbid states become developed, not necessarily connected with the primary affection, but forming secondary lesions to the disease, and constituting the third form in which *dysentery* must be studied, namely,—

Complex Cases of Dysentery.—There are various secondary lesions which render cases of dysentery complex, and which are regarded by some as directly connected with the primary affection.

There are also secondary lesions connected with antecedent forms of disease, which sustain a renewed impulse to their development by the dysenteric state. These secondary lesions may be shortly stated to consist,—(1.) In lesions of the small intestines, and of various solid viscera more or less connected with the dysenteric state; and (2.) In lesions which may be referred to the co-existence of certain morbid states of the patient with the dysenteric condition, such, for instance, as the *typhous*, *scorbutic*, and the *tuberculous* state.

Anatomy of the Morbid Tissues in Acute Dysentery.—The accounts of the morbid anatomy of dysentery are especially confusing; and while the disease has been mainly recognized during life, and defined as a febrile disease accompanied by tormina, and followed by straining and scanty mucous or bloody stools containing little or no fæcal matter, yet the local lesions associated with these conditions have not been clearly defined nor uniformly described.

For example, Chomel and his school considered that the local lesion in dysentery consisted in congestion simply, and tumefaction of the mucous membrane, especially in patches of some extent, so as to form dark-red or purple prominences, from the surface of which the epithelium becomes detached by desquamation. Cruveilhier believed that dysentery was an erythematous inflammation of the large intestine, quickly followed by sphacelus; and he emphatically insists on the point that the follicles and solitary glands have no share in the disease. "It is not," he says, "a follicular inflammation." Rokitansky includes these two forms of lesion as essential in dysentery.

The disease, as described by each of these observers, is regarded as a process of rapid, and at first of superficial, inflammation, leading inevitably and speedily to mortification, and unattended by any special disease of the solitary glands. Rokitansky states that, even in the slightest variety of dysentery, the mucous membrane is swollen and red, and may be removed in the form of a pulp from beneath the furfuraceous and vesicular epithelium. In after stages, and in the severer forms, the mucous membrane becomes gelatinous, and is easily separable, or it passes into a state of sphacelus, black, friable, and offensive. All these observers regard ulceration as having no essential part in the disease-process which constitutes dysentery, and as being of very rare occurrence.

Some of the writers who have described the tropical forms of the disease have been still less distinct as to the details of its morbid anatomy. For example, Twining seems to have followed Chomel in considering the lesion to be a simple inflammation of the mucous coat; and Annesley is in a great measure unintelligible as to the points of morbid anatomy which he describes. It was not till Dr. Parkes published his minute and admirable description of the morbid anatomy of dysentery, as he saw it in India, that we had anything definite on the subject as regards the tropical forms of the disease. He not only showed the very early implication of the glandular apparatus of the great intestine in dysenteric inflammation, but he established the fact, so far as his cases went, that, while ulceration occurs with great rapidity, a case never presents true dysenteric symptoms without ulceration being present. At Moulmein, in India, he investigated, in 1843-44, cases of dysentery in Europeans to the number of fifty, and in Asiatics to the number of twenty. He concluded from these observations that,—(1.) Certain alterations in the glands of the mucous membrane of the large intestine, and sometimes of the ileum, constitute the earliest lesion in dysentery. (2.) That in all cases, when not too far advanced, the mucous membrane presented the appearance of numerous whitish round elevations, of a size varying from a millet-seed to a size so minute that a lens only can show the lesion. These elevations were hard, and being pierced, gave forth a white excretion. Many of these had a black speck in the centre, and were surrounded by a vascular circle. (3.) He noticed that exudation sometimes occurred in points beneath the mucous surface; that such points of exudation had a white appearance, with contents similar to those of the solitary glands. The mucous membrane over these points could be easily rubbed off, leaving an ulcer (Parkes *On the Dysentery and Hepatitis of India*).

NB

The observations of Dr. Parkes were thus opposed to the views just stated, and led to extended investigation, by which such contradictions may be reconciled; and it was determined that differences of climate do not cause any essential difference in the structural changes which accompany dysentery. The observations of Drs. Craigie and Abercrombie in Scotland, in 1837, prove this; and also those of the late Dr. Baly, in 1847, as regards England. Drs. Cheyne, Graves, and Mayne have demonstrated the same fact as to Ireland. By the records of epidemic dysentery at Prague and elsewhere, as described by Dr. Finger and others, the observation holds true as regards the dysentery of Europe generally; and by comparing these records with the well-recorded cases of those who have seen the disease in the tropics, both in civil and in military life, it will be seen that the true dysentery of tropical and temperate climates does not differ *as to its anatomical signs* in any essential particular.

The descriptions of the disease in our own country, as given by Cheyne, Craigie, Abercrombie, and Baly, all agree in recording the inflamed condition of the mucous membrane of the colon, with its small round ulcers, pulpy softening, or sphacelus of some portions, and ulcers of various forms left by the separation of the sloughs, and enlarged firm tubercles, which no doubt were the inflamed solitary glands. Again, Sir John Pringle, M. Broussais, and other historians of dysentery, found the same lesions in the dysentery of the camps in the continental campaigns of Europe; and Broussais expressly states his belief "that the ulcers of the large intestine had their origin in the solitary glands." Thus the "tubercles," the "pustules," and the "small-pox-like elevations" of the mucous membrane have been most minutely described by Hewson, Pringle, and Davis; and the last of these observers describes in graphic language the fatal dysentery of the Walcheren expedition, and shows that its anatomical characters are similar in all respects to the forms of dysentery which have been described in this country.

We have therefore only to compare all these records with the histories of tropical dysentery, as given by Zimmerman, Annesley, Pringle, Copland, Dr. Hunter, Chisholm, Ballingall, Parkes, Morehead, Sir Ranald Martin, Tait, Macpherson, and others, to know,—"whether any peculiar character of the anatomical changes in the large intestine essentially distinguishes the dysentery of intertropical countries from the dysentery of this and of other temperate regions." Dr. Abercrombie admitted identity in the nature of the dysentery; but, that extent of the intestine affected varies considerably. Dr. Craigie showed that the lesions in dysentery occur in two forms; one continu~~es~~ous over the surface, the other limited to the *muciparous follicles,* which become enlarged, indurated, and ulcerated; while, on the other hand, Dr. Baly has shown that all the well-marked varieties of structural change in the large intestine occurring in tropical dysentery are likewise found in fatal cases of the disease occurring in our own country.

Seeing, then, that the descriptions of the morbid anatomy have been so much at variance with each other, several questions suggest themselves, namely,—(1.) Whether distinct epidemics are characterized by distinct local lesions? (2.) Whether two or more distinct diseases have not been confounded under the one name of dysentery? Or, (3.) Whether the various local lesions described by different writers are only so many varieties, forms, or types of the same disease-process—a process modified in particular cases by constitutional peculiarities, or by other circumstances. This latter view is the one most consistent with observation; and it is in accordance with what we know of the history of many of the *miasmatic* diseases, such, for example, as *true yellow fever, remittent fever, diphtheria,* and the like. There is some evidence, also, to show that there is a lesion of the colon not belonging to true dysentery—a *colonitis* in which the connective tissue of the gut beneath the mucous membrane is implicated in the first instance, rather than the glandular tubes and vesicles. The result is a diffuse gangrenous inflammation of the mucous membrane, the resulting ulcers not differing from the ulcers originating in the glands by any characters at present recognizable (Copland, Parkes.)

In this country it is believed that the lesion in dysentery is confined, for the most part, to the colon and rectum; but that in tropical dysentery the whole course of the colon, and sometimes a considerable portion of the small intestines, are implicated. But, except when the case is associated with *scorbutus,* the small intestines are not involved. Lesions so extensive, while they are common in India, are rare in this country; yet they do occur, and are not uncommon in the south of Europe, in Turkey, and the coasts of the Mediterranean. Therefore, as regards the extent of the lesion, there is no constant or distinctive characteristic between tropical dysentery and the dysentery of more temperate climates.

In both regions the anatomical changes comprehend redness of the mucous membrane, preceding further changes; loss of the substance of the mucous glands by pulpy softening of tissue, sloughing, or ulceration; the detachment of diphtheritic casts of the intestine, or sloughs of tissue.

In describing the morbid anatomy of dysentery the reader is

Normal structure of
Colon

referred to the nomenclature of the gland structures, given in a footnote at page 397 of the present volume. The structure of the colon in the healthy state differs in many important particulars from that of the small intestine. It is remarkable for the absence of folds and villi, and for the presence of more or less dilated sacculi, which give form and shape to the excrement. The minute tubular glands are thicker in proportion to their length, compared with those of the small intestine; and the intertubular connective tissue is considerable,—a structure which takes an important share in the lesions of dysentery. These tubular glands are lined by columnar, cylindrical, and transition forms of epithelium; and the solitary lenticular glands are sometimes closed vesicles (Allen Thomson, Parkes, Baly), and sometimes open follicles. When closed, they are not visible; but if distended, they may be seen with a lens; and when open, a dark depressed point marks the separation in the tubular gland structure which leads to the open follicle. The tubular glands radiate round this spot, which corresponds to a depression indicating the empty vesicle below. These solitary vesicles have thick walls, and are said to be more abundant in the cœcum and rectum than in any other part of the great intestine. This statement leads to the question which has been mooted in relation to these solitary gland lesions, namely,—"Are these lesions of the so-called solitary glands really due to the enlargement of previously existing solitary glands or their germs? or, Are they new formations altogether?"

A similar question is at issue regarding the granulations on the eyelids and conjunctivæ, associated with purulent ophthalmia (Stromeyer, Frank, Marston). In this disease we have *new formations* of vesicular-like granulations, as well as enlarged follicles; but these are more numerous than the glands have ever been seen to exist in the healthy state. Observations somewhat similar have been made regarding the vesicular glands of the stomach (Handfield Jones). It may be, therefore, that not a few of the "tubercle nodules," the "pustules," the "small-pox-like elevations," and what we call solitary or lenticular glands, are in reality new formations altogether, resulting from increased cell-growth, within the meshes of the connective tissue which binds the mucous gland tubes together, and connects them with the submucous muscular layer. In this respect their formation would be analogous to that described by Virchow in connection with tubercle, and not to be distinguished histologically from a newly formed grey tubercle nodule. So independent have these lesions been believed to be by some, that one observer of Indian dysentery (MURRAY) described a "pustular form of dysentery," which he considered to be in all respects analogous to small-pox on the skin, beginning with the formation of an independent papule and the development of a subsequent pustule, as in that disease of the skin. This view of the subject is of some importance in pathology, as it is related to the specific nature of dysentery and the poison cast off from the mucous membrane, by which it is believed that the disease is propagated like typhoid fever and cholera (DR. WILLIAM BUDD).

Seeing, therefore, that the anatomical signs of dysentery are so constant over all the world, it may be asked, How have modern writers given such contradictory accounts of the morbid anatomy of the disease? The best writers have differed on points of observation simply,—(1.) Some deny the necessary occurrence of ulceration; (2.) Some deny any special participation of the lenticular glands; (3.) Some believe that new formations arise, which are similar in appearance to those small glands; (4.) Some, on the other hand, believe the disease, at its commencement, to be always seated in these small glands; (5.) Some regard dysentery as essentially an erythematous inflammation, terminating in gangrene; (6.) Others believe that such gangrene is a very rare variety of the disease.

To explain such discrepancy, it may be said that,—(1.) Observations have been too limited, and not exact enough, to give an accurate and comprehensive view of the morbid anatomy of the disease; that dysentery, although a simple and uniform disease, so far as its anatomical signs are concerned, yet ~~it~~ is liable to constant changes of type, from its remarkable proclivity to complicate prevailing fevers (specific or endemic), as well as other diseases (e. g., *typhoid fever, malarious fevers, fever from the poison of animal effluvia, scurvy, syphilis, phthisis, measles, variola,* and the like); (2.) The healthy or normal anatomy and histology of the mucous membranes are only yet beginning to be understood and studied minutely at our Schools of Medicine; (3.) The examination of the colon, upon which descriptions have been based, has often been incompletely done, as Annesley very correctly pointed out; (4.) The inherent difficulties of the subject itself, such as the impossibility of seeing the state of the diseased membrane till after death. From all the observations that have been made, there can be no doubt that the anatomical signs of true dysentery are primarily derived from inflammation of the solitary lenticular follicles of the large intestine, tending in the first instance to infarction (*i. e.*, intumescence and congestion), and subsequently to ulceration and destruction of the gland tissue. The disease, extending by a similar process, ultimately involves the tubular glands of the general mucous membrane, which tends to soften and to be cast off as an exuvium or slough, exposing the submucous connective tissue or the muscular coat of the intestine. It is the mucous membrane of the great intestine, and especially of the rectum and lower portion of the colon, which is the seat of these characteristic lesions in dysentery. The exudative process is generally diffuse, involving the whole of the tissues of the mucous membrane. In some cases, however, it is seated in the solitary glands, in the first instance, and neighbouring mucous tubular glands.

In the scorbutic form of dysentery, or in dysentery occurring in persons whose nervous or vital powers are feeble, or below *par*, as in the aged, infirm, or in the paralysis of the insane (conditions in some respects similar in their influence to *scorbutus*), a diphtheritic exudation covers to a considerable thickness not only the mucous surface of the colon, but (as an almost constant and pathognomonic morbid sign) the same lesion is seen covering the mucous surface of the small intestine, extending upwards from the ileo-colic valve; and, as Dr. Parkes has noticed, this exudation grows or is laid down especially in the course of the blood-vessels ramifying from the mesenteric attachment transversely across the surface of the gut, and occupying especially the prominences of transverse rugæ. This form of dysentery prevailed to a great extent among the soldiers who died at Scutari during that period of the Russian war when scorbutus prevailed. Some of the cases recorded by Dr. Davis in his admirable description of the dysentery so fatal to the British troops in the famous Walcheren expedition were also of this nature. Dr. Finger, of Prague, and Dr. Maine, of Dublin, and Dr. Baly, have recorded similar cases; but one of the best accounts of this form of dysentery is that which Dr. Clouston records as having prevailed in the Cumberland and Westmoreland Asylum, and which he believed to have been caused by the effluvia from a field irrigated with sewage. The regular diet of the asylum inmates consisted of 24 ounces of animal food, 14 pints of milk, 16 ounces of suet dumpling, 7 pints of oatmeal porridge, 78 ounces of bread, and 7 pints of tea per week (*Med. Times*, June 3, 1865). No fresh vegetable diet seems to have been provided for; and diarrhœa does not seem to have been uncommon.

In typical cases of the outbreak described by Dr. Clouston—

> "All the abdominal organs would be found healthy until the small intestine was examined. This, too, would be normal up to within five or six feet of the cœcum. The mucous membrane would then begin to appear reddened in small spots or rings round the gut. Six inches farther down the redness would be universal, and the membrane would begin to be thickened and corrugated into folds, like small *valvulæ conniventis.* A few inches farther down, a yellowish, dirty-looking deposit would be seen over the mucous membrane in rings, very thin where it began, but gradually becoming thicker and more continuous till near the cœcum it would be one-eighth of an inch in thickness. The swelling of the mucous membrane would also increase downwards, and the folds running across the gut would become more prominent. These, with their coating of deposit, made the inside of the bowel look like a series of thick transverse ridges, covering its entire surface. This deposit, when examined, would be found to be soft on the surface, but getting more firm towards the mucous membrane, with which it incorporated itself, so that it could not be scraped off without leaving the fibrous covering of the muscular coat exposed as a highly vascular, raw-looking surface. This deposit, though on the surface a soft lymphy-looking substance, yet towards the mucous membrane ~~it~~ assumed quite the consistence and appearance of a soft fibrous membrane. The cœcum, when examined in such a case, would be found in the same state as the lower part of the small intestine, with two or three ragged ulcerations the size of beans. In the ascending colon the ulcerations became deeper and larger; still the lymphy deposit on the surface of the mucous membrane became thicker and more feculent in colour. Towards the transverse colon the inside of the gut was one mass of large irregular ulcers, with patches or the deposit between them. The colour of the surface was almost black, and this continued down to the very lower part of the rectum. The mesenteric glands opposite the affected parts of the small and large intestine were enlarged and dark-coloured, and on section were soft and pulpy in consistency. Such were the general appearances in a case that had lasted for about a month" (*Med. Times and Gazette,* June 10, 1865, p. 598).

The morbid anatomical states which I have been able to distinguish throughout numerous dissections of cases of dysentery may be stated as follows:—

1. Exudation obvious on the surface of the mucous membrane of the rectum and colon.

2. Exudation not obvious to the unaided eye, but which was seen, in all the cases examined by the microscope, to fill the mucous tubular follicles of the large intestine.

3. Exudation obvious to the eye, and demonstrable by microscopic examination as being developed in the solitary vesicular or lenticular glands of the large intestine.

4. Changes in the exuded material, which tend first towards its organization, and subsequently to its destruction and removal by ulceration.

5. Softening and ulcerative changes in the tissues of the mucous membrane itself, and in the glands.

6. Similar dysenteric lesions extending into the *small intestines*, as in the scorbutic states of the system.

The extent of the exudative process varies much. In some cases a considerable portion of the *colon* and *rectum* only is affected; in other instances not only is the whole of the great gut the seat of some form of the exudative process, but the lower portion of the small intestine also. The most commonly affected portions, however, are the *rectum*, the *sigmoid flexure*, and the *descending colon*. When the *caput cœcum* of the colon is involved, the *vermiform appendix* participates in the process. Creamy-like exudations have been seen to fill its tubular glands, which in some cases were opened up by ulceration.

In the least severe cases an opportunity does not often occur to see the changes in an early stage; but when life is cut short by some other malady, changes of the following nature may be seen:—

The exuded mucinous material, in its more recent state, forms a layer, which varies from a thin but opaque membrane to three or four lines in thickness, of homogeneous substance, tolerably consistent, and capable of being detached and raised in flakes from the subjacent mucous surface. During the earlier stages of the disease the surface of the mucous membrane appears unchanged below, except, perhaps, by the existence of a little increase of vascularity. The colour of the exuded matter may be uniform or red, white, or pink in patches, and discoloured in some instances by intestinal gases, the biliary secretion, or by the admixture of blood, and the changes consequent thereon. The most common appearance in severe cases is that of a dark olive-green, passing into a bluish-black. The surface of the exudation may be uniform, or the whole aspect may be mammillated, with here and there a *mammillation* projecting greatly above the others in a fungating mass, surrounded by dark fissures in the exudation. These fungating masses are soft towards their centres, with numerous red vascular points here and there on the surface. A section through the mass shows the base thickened and firm.

The dysenteric process, as seen after death, is generally found to have advanced farther in one part of the intestine than in another; usually, it may be stated to have been farther advanced in the *rectum* than in the *descending colon*, and farther in that part than towards the head of the large intestine. In well-marked and extreme cases the entire mucous surface, from the *caput cœcum* to the *rectum*, may be seen to present all the possible stages of the dysenteric process. Three stages can in general be distinguished, namely,—(1.) Ulceration of the exudation, and mucous membrane more or less advanced towards the *rectal end* of the great intestine; (2.) Exudation in various forms towards the *middle* of the *colon* upwards from the *rectum;* (3.) The exudative process visible microscopically in the tubular glands, and sometimes also obvious to unaided vision in the solitary vesicular glands of the great intestine towards the *caput cœcum.*

NB

One of the best descriptions of the morbid anatomy of dysentery in the English language has been given by the late Dr. Baly in his Gulstonian Lectures for 1847. He describes *three* different forms of lesions as seen by him amongst convicts at the Millbank Prison; and these three forms he believed to correspond with three degrees of severity of symptoms during life,—(1.) He recognized a swollen condition of the solitary glands, forming round prominences on the surface of the mucous membrane, of various sizes. In colour these were pale, or red round the base, and dotted at the summit with a vascular spot. These appearances would occur about the eighteenth or twentieth day. At an earlier period the congestion round the glands would be more intense; while at a later period the summits of the prominences would become disorganized. Minute yellow sloughs subsequently form, which, becoming detached, leave an ulcer previously occupied by the gland. The mucous membrane around participates in the process. It is red, tumid, and covered with an aphthous layer of lymph, to the extent of one or two inches around, with three or four solitary glands prominent in the midst. The ulcers which form result from sloughs rather than from ulceration; and the disease still remains *not severe,* as regards the amount of tissue involved; but *as to duration,* the illness may be prolonged and tedious; and the solitary gland cavities may enlarge very much,—so large as a horse-bean. (2.) In more severe forms a greater variety and extent of tissue is involved; and especially of the tubular glands. There is great redness, tumefaction, and softening of tissue; and along with the change of colour and of texture the secretions are greatly altered. The clear mucus is highly charged with albumen, and subsequently with blood.*

These changes occupy principally the prominences of the transverse rugæ. The exudation on the free surface in the recent condition may form a thin opaque membrane three or four lines thick. It is homogeneous and of considerable consistence, so that it may be detached, and raised in flakes from the subjacent surface. With the exception of increased vascularity, the subjacent mucous surface appears still unchanged. A microscopic examination of this exudation shows that it varies with the severity of the case to some extent. In mild cases it is simply particles of epithelium mixed with amorphous granules. In more severe forms the exudation consists of fine germs with nuclei, mixed with elongated cell-forms (connective tissue cells); and the examination of carefully prepared sections shows that such exudation mainly commences in the tubular glands, and by proliferation subsequently spreads over the mucous surface as described. In Dr. Clouston's cases examination of the fibrinous layer (over the small intestine), in the fresh state, showed its structure to consist "of nucleated cells like pus-cells, furiform cells with nucleus, and a fibrinous material between them." The blood-vessels underneath the "fibrous layer were enlarged and

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[*] Some account of the chemistry of the stools in dysentery has been given by Oesterlen, who describes an excessive elimination of water and of albumen. It is very desirable that this observation should be verified in India. The stools should be collected free from urine; and the albumen should be estimated separately from any insoluble sediment. If in severe cases two and a half ounces of albumen are passed in twenty-four hours by stool, it is impossible to over-estimate the importance of such an occurrence.

very tortuous, and on the free surface of the mucous membrane, between the villi, they could be seen torn and open-mouthed," (*Med. Times*, l. c.)

Exuviæ, or casts of the intestine, may now be thrown off in large masses or shreds, leaving a raw-looking vascular surface underneath; and in some respects this process and these casts are analogous to similar phenomena in *croup*, *diphtheria*, *dysmenorrhœa*, and to *typhoid fever*. By carefully examining the evacuations, important information may be obtained as to the nature of the process going on in the intestines. Dr. Goodeve, of Calcutta, has made some valuable observations of this kind. He recommends that the evacuations should be washed with water, so as to get rid of the fæcal matters entirely, and so leave the sediment, which is the product of the colonic disease, free from bile, fæcal matter, and offensive smell. He observed that patches of membrane, half an inch or an inch or more in size, are cast off as sloughs. These exuviæ are thin, membranous, and sometimes infiltrated with pus; or they are thick and of a yellowish-brown colour. It is not till after the *eighth* or *twelfth* day of the disease that such sloughs are cast off. In these respects they may be considered similar to those cast off from Peyer's patches in typhoid fever. After these shreds are cast off the symptoms diminish, and the patient often gets well rapidly.

During the shedding of the shreds the patients are much griped, and they pass with straining the sanguinolent masses, or slimy mucus in small quantities, and generally without fæcal matter, fifteen or even twenty times a day. Then a period of cure and improvement supervenes, with diminution of the stools or of the fæcal discharges,—not simply by resolution, but a termination by elimination of the specific sloughs or lesions which have formed in the course of the disease. In this respect the phenomena seem analogous to what occurs in typhoid fever. When these membranous flakes are not shed, but retained and ultimately separated in large pieces, there is considerable danger attending the process. Discharges of blood and fatal hæmorrhages may ensue. Morehead records eight cases of this kind in India, and four of them were fatal, of whom one died from hæmorrhage. To account for this hæmorrhage, it has been observed that changes go on between the intertubular connective tissue and the substance of this exudation, which tend to its organization or supply with blood, and subsequently to its destruction, separation, or removal by ulceration. In vertical sections, down to and through the mucous membrane, I have seen fine blood-vessels, in loops and bulbous cœcal ends, shooting upwards beyond the mucous surface into the exudation; and when such exudation was forcibly removed from off the mucous surface, the membrane on which it lay was found to be highly vascular, and numerous minute ruptured vessels showed their torn mouths, by minute points of exuding blood. Dr. Morehead records a similar observation as regards the connection of the exudation with the subjacent mucous tissue, "through the medium of what appeared to be small capillary vessels, the mucous membrane beneath being vascular" (*Researches on Disease in India,* p. 241). In a case that proved fatal at the end of six weeks, and in which the gut was so friable that almost the least current of water tore it up, Dr. Clouston noticed that "in the rectum blood-clots projected from the open mouths of arteries."

When such a state of vascular action in the mucous membrane and exudation has existed for a lengthened period, the tissue of the gut becomes greatly thickened, and at the same time less coherent. These thickened portions grow luxuriantly, just as isolated patches in a field of green corn grow more luxuriantly than others, being supplied with a greater amount of nutritive material, as the thickened patches of mucous membrane are supplied with more enlarged, more tortuous, and more extensively distributed loops of blood-vessels. These thickened masses of dysenteric exudation continue to fungate and grow from a hardened base, from which the numerous blood-vessels pass into the growing masses. In this way the warty condition of the mucous membrane in chronic cases undoubtedly results. The new material evinces a disposition to contract. The calibre or bore of the gut gradually diminishes, and its texture becomes so brittle that slight force in pulling up a piece of such intestine out of its place will readily cause it to *break* asunder.

NB

As to ulceration, it may be readily understood, with such varied lesions, that the formation of ulcers does not take place in any uniform mode; and the following statement is given as a summary of the processes from which ulceration may proceed:—(1.) It may occur after intumescence, softening, and simple ulceration of one or of several lenticular solitary glands. (2.) After intumescence, softening, and sphacelus of many solitary lenticular glands and the intervening tissue in one mass. (3.) After softening of the tubular structure and the detachment of sloughs, ulceration follows the intumescence and proliferation of growths from the tubes which cover the surface as a "croupous," "catarrhal," or "diphtheritic" exudation, and to which the name of "aphthous erosions" has been applied. (4.) After submucous inflammation and new growths, with fibrinous and mucinous effusion. (5.) After intertubular inflammation, and after inflammation surrounding the base of inflamed glands. (6.) After the formation of submucous abscess. (7.) By changes of an ulcerative nature, commencing in the vascular exudation itself, as in scorbutic cases.

The *circular* ulcers, for the most part, originate in the solitary glands (PARKES, BALY), or in circular patches of tubes (MOREHEAD), similarly to the stomach ulceration, as described by Drs. Handfield Jones and Brinton; or such circular ulcers may result from both, as when a solitary gland is destroyed it carries with its destruction some of the adjacent tubes. In such cases the colon presents prominent little masses, about the size of a pea, which burst readily on pressure, and give forth fluid contents like pus. Such abscesses may open spontaneously upon the mucous surface through the short canal leading from the vesicular gland (now an abscess), imbedded in the submucous tissue, and between the tubular glands. They undermine the tubular gland substance, and carry off shreds or patches of the surrounding tissue. They may thus be seen in all stages, and sometimes almost symmetrically arranged in a double row along the colon (BLEEKER, MOREHEAD). Many of these little abscess cavities are also formed below patches of thick exudation (HASPEL).

The *transverse ulcers* are due to the transverse arrangement of folds, on which the exudation and textures ulcerate, as already described; and I have known the transverse *rupturing* of very thick exudation mistaken at *post-mortem* examinations, for ulceration, on seeing the raw vascular surface of the tissue exposed below at the bottom of the rent.

Microscopically the exudation in its most recent condition may be seen to be composed of fine germs and nuclei, with elongated nuclear cells. It appears to be chiefly exuded into the follicular and tubular apparatus of the mucous membrane, and gradually accumulating there, is pushed upwards to the mucous surface, which it finally overspreads as a whitish coat, coherent and uniform, susceptible of vascular organization, and tending to ulcerate.

Anatomy of the Tissues in Chronic Dysentery.—In the true chronic form of dysentery the exudation already noticed undergoes various changes. It may be thrown off from the mucous surface altogether, leaving that surface bare and raw-looking, as if ulcerated; but a close inspection will show that the surface is entire and highly vascular. If it is not thrown off, it may undergo a considerable amount of organization; after which it appears that a process of ulceration may be established upon its surface, just as in any other soft tissue. This ulcerative process may extend through the whole exudation, even to the surface of the mucous membrane, which it may penetrate also, and involve the tissues of the intestine in the ulcerative process close to the peritoneal coat. Perforation of the peritoneum is by no means uncommon.

In the chronic forms of dysentery there is a very constant morbid change to be observed, consisting in the deposit of black granular matter on some parts of the mucous membrane. It may be regarded as the result of excessive vascular action, and of subsequent changes in the extravasated blood, elements which mark the site of the melanic spot (pigmentary degeneration; see page 117).

The sigmoid flexure of the colon is perhaps the most frequently and the most extensively diseased, and the lesion is most expressed towards the rectum. In very severe cases the exudation extends over the whole extent of the mucous surface of the *colon*, which appears covered with black, grumous, carbonized-looking masses, even to the upper part. Ulceration is most frequently seen in the *sigmoid flexure*, destroying at once the exudation and the mucous membrane, so as to expose the muscular tissue of the gut, which is red and irritable. An *appearance* of ulceration often extends in lines across the gut, so as to embrace its whole calibre in some parts. This is sometimes, however, only an appearance of ulceration, caused by the separation of the exudation when it is thick, exposing the highly vascular mucous surface below, which looks raw and ulcerated. When the gut is opened in the usual way after death, and extended on a flat surface, the change from the hitherto curved condition of the intestine is so great as to cause rupture or separation between masses of exudation, especially in places where it is thick; thus giving rise to the appearance noticed, and which has sometimes been described as ulceration. In long-continued chronic cases the rectum is generally studded over with punched-out-looking ulcers with bloodless bases and thin anæmic edges; and the melanotic deposit, already noticed, is here seen in the greatest abundance. Evidence of healed ulcers, with partially renewed mucous tissue covering them, are not uncommon in this locality, their place being indicated by the amount of black matter. The gland tissue, however, is not reproduced in the cicatrix substance.

Anatomy of the Morbid Tissues in Complex Cases of Dysentery.—In the class of dysenteric cases which may be called *complex* there are a variety of lesions, the pathological significance of which as to extent, form, origin, and locality, renders the cases of dysentery in which they are found of a very complex kind. The lesions which chiefly tend to render cases of dysentery complex, are,—(1.) Extension of the dysenteric process over the mucous membrane of the small intestine; (2.) Deposits and ulcerations in the glands of Peyer, as well as in the general tubular structure near the ileo-cœcal valve; (3.) Atrophy of the glandular parts of the mucous membrane of the alimentary canal; (4.) Secondary lesions of serous membranes; (5.) Secondary lesions of solid viscera in the cavities of the *abdomen* and *thorax;* (6.) Secondary lesions due to the syphilitic, scorbutic, typhus, or tuberculous states, or to the influence of malaria.

In some rapid and acute cases of *dysentery* (five out of twenty-eight cases, as observed by Dr. Baly) it has been noticed that the process by which the *dysenteric lesions* were developed in the large intestine extended beyond the ileo-cœcal valve, and brought about an action in the small intestine similar to that in the colon. As much as the lower two-thirds of the ileum have been involved in this process, while the upper portion has been found intensely congested. In one case of *dysentery*, Dr. Cheyne says he found an exudation of lymph extending nearly over the whole of the jejunum. If the stomach participates in the disease, the mucous membrane may be merely diffusely inflamed, or of a red or violet colour, its surface granulated, and its texture broken by the slightest touch. More commonly the colour of the mucous membrane is natural, but on its surface a number of ecchymosed spots, or small ulcers, are seen, with edges so sharp, clean, and perpendicular, that they appear as if made with a punch. In other cases the tubular glands, as well as the solitary and aggregate glands of Peyer, have shown various stages of morbid action. The absorbent mesenteric glands are rarely affected (Baly); but except in cases of secondary hepatic abscess, they were found enlarged and inflamed in all cases of Indian dysentery (Parkes), and also in the dysentery associated with *scorbutus.*

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By far the most common condition, however, in chronic cases of *dysentery* especially, is that which is due to atrophy of the mucous membrane. As an atrophic change, it may be ascribed to the general wasting (marasmic) processes which take place to a great extent throughout the system in cases of *chronic dysentery.* In this complex state the mucous membrane of the *small intestine* appears pale, thin, and worn,—a condition which pervades the greater part of the alimentary canal, and which is especially made manifest in the living as well as in the dead by the condition of the mucous membrane of the mouth. On turning down the lips, the mucous glands are seen distinctly projecting through the thin pale labial and buccal mucous membrane. When such cases are examined after death, the structure of the solitary glands and of Peyer's patches are found to be degenerated and wasted; no gland-cells are to be seen, and their place is supplied by fibroid tissue, with some vascular injection round the reticulated spaces. In other instances a deposit of black pigment surrounds the locality of the glands, which indicates the long-continued process of vascular action previous to their atrophy. Associated with this general atrophic state, some gland-patches may be observed in an apparently opposite state—that is, distended, and sometimes engorged; but, on examination, their contents appear to be undergoing a molecular, melanotic, and generally fatty degeneration, probably preparatory to complete evacuation and destruction of the gland-element. These two apparently opposite conditions, co-existing in the same cases, appear to indicate that the one condition is but the antecedent of the other; and that the atrophy and degeneration is the last result of a series of morbid processes commencing in the engorged gland-cavities.

In parts of the mucous tissue which exhibited the opposite conditions of extreme hypertrophy and extreme atrophy, the specific gravity of the former indicated 1·046, while the thin and wasted part of the intestine indicated a specific gravity of 1·036 to 1·030.

There is now abundance of evidence to show that, in some endemic cases, or in epidemics of *dysentery* in some places, there is a tendency to the secondary affections of organs or parts, during or subsequent to the development of the dysenteric process. Some look upon these secondary processes in relation to the dysentery as in the relation of effect following a cause; or that there is an immediate and direct connection between the primary dysenteric process and the secondary lesion. Such a relationship has not been shown to exist in all cases; and it is more probable that the *dysenteric* process, when it operates on the system during a protracted period, predisposes, as many other morbid states do, to the development of secondary local lesions in distant parts.

The arachnoid, the pleuræ, the pericardium, and the peritoneum have each and all of them in some instances been the seat of opacities or of fluid exudations in dysenteric cases.

Of morbid states of the solid viscera, associated with dysentery, by far the most frequent complication is that with the *kidney* and the *liver*. With regard to the kidneys, their relation to the bowel affection is as yet obscure; but in mild cases, proceeding to a favourable termination, there is no albumen and no casts in the urine. When, on the other hand, the dysentery is severe, it continues some time before exudation appears in the urine, and then its occurrence is preceded and attended by putridity of the copious stools, by *status nervosus*, collapse, and paralytic phenomena. If the renal affection occurs early, so much more severe is the case, and death usually speedily ensues. The kidneys after death are seen to be highly congested, the tubes loaded with exudation, cells, and detritus (Zimmerman, *Syden. Society Year-Book* for 1861).

The association of hepatic disease with *dysentery* would seem to be most frequent in the climate of the East Indies, and in such climates as have a similar influence (MARTIN). In the Bombay Army, out of thirty fatal cases of *dysentery*, twelve were attended with hepatic abscess (MOREHEAD). Dr. Macpherson, Sir James M'Grigor, Dr. Parkes, and Mr. Henry Marshall, gave similar statistical results of their experience at Calcutta, Moulmein, and

Ceylon. The French surgeons in the province of Oran, in Algeria, state that hepatitis and consequent abscess were frequently coincident with dysentery. Dr. Parkes observes, that if the functional morbid state of the liver is to be judged of by chemical analysis of the secretion of that viscus, the liver is found to be diseased, more or less, in every case of dysentery. Dr. W. J. Moore, Assistant-Surgeon of the Bombay Army, has collected a valuable series of statistics, which sets in a stronger light than hitherto the relation of hepatic *lesions* to dysentery. The records of five independent observers show *lesions* of the liver (not being abscesses) in about 57 *per cent.* of the cases; while the number of cases in which *abscess* was observed averages about 18 *per cent.* (Grant's *Annals of Military and Naval Surgery,* vol. i., p. 227). The tendency to hepatic complication was found in Algeria to increase with age, and with the length of service in that country. It appears, however, that hepatic *abscess* is but rarely associated with dysentery in natives of those warm climates; and amongst British subjects in their native climate it seems equally rare. In the Millbank Prison, "out of many hundred cases, not one has been complicated with hepatic *abscess.*" It does not appear, however, that the influence of the climate of the East alone on Europeans tends to the hepatic complication, for "in the Peninsular Army, under the Duke of Wellington, the spleen, the liver, and the mesentery were generally found diseased in cases of dysentery; so were these viscera in the epidemic dysentery of Ireland" (MARTIN). In the dysentery of the allied armies in the hospitals of Scutari and the Crimea during the late Russian war, hepatic abscess was of rare occurrence. Dr. Budd attempts to explain how hepatic abscess is a *consequence* of dysentery through the vitiation of the portal blood from the morbid intestines. But the evidence tends rather to show that the hepatic lesion and the dysentery are each excited by the same cause. If Dr. Budd's theory were correct, we ought to have liver abscess a common occurrence after ulcerations of typhoid fever, and after those of tuberculous lesions of the intestines; but we do not find that such a lesion of the liver is usual in such cases.

Regarding hepatic complication in dysentery, the following conclusions may be stated:—(1.) That dysentery, in a great number of cases, more than a half, commences and runs its course complicated by obvious functional hepatic disease; (2.) That the hepatic disorder and the dysentery acknowledge a common cause and disease-process; (3.) That about 18 *per cent.* of the fatal cases of *dysentery* are complicated with hepatic abscess; and about 57 *per cent.* with hepatic lesions; (4.) That in a few of these cases ulceration of the intestine may be the primary disease, and the source of the hepatic abscess by the phenomena of thrombosis and embolism in connection with the pelvic veins and veins of the mesocolon.

The occurrence of hepatic abscess with dysentery has been generally viewed as a result of phlebitis; but Dr. Parkes, after the most careful observation of such cases, never found the slightest trace of inflammation in the small veins of the intestine, while no direct proof has been advanced of the mediation of the portal blood in the process; and in conclusion, writes Dr. Henoch, "I believe we must give the preference to that view which regards the two diseased processes, dysentery and abscess of the liver, as running their course together, dependent upon one and the same cause; in favour of which view is the circumstance, that in hot climates abscess of the liver very frequently occurs associated with remittent fevers, or consecutive to them, without dissection exhibiting any ulceration of the mucous membrane of the intestine" (*Brit. and For. Med.-Chir. Review*, July, 1854). The comparative frequency of the occurrence of hepatic abscesses may be seen from the following statement:—

In *Calcutta* General Hospital they occur at the rate of 13·1 *per cent.* (Macpherson); in the Medical College Hospital, at the rate of 25·9 *per cent.;* in *Bombay* General Hospital, at the rate of 40 *per cent.* (Morehead); and in *Madras* Presidency, at the rate of 50·97 (Annesley), 19·35 (Parkes), 17·9 (Innes, at Secunderabad); Macnamara, in Madras, 50·9 *per cent.;* French surgeons in Algeria, 12·7 *per cent.;* Eyre, of the Madras Fusileers, 22·8; Warring, in various localities not stated, 23·5 *per cent.;* Stovell, in European General Hospital, Bombay, 19·3 *per cent.;* Leith, in Bombay, 8·5 and 15·2 *per cent.;* and Marshall, in Ceylon, 28·8 *per cent.*

Too much attention and importance seem to have been put upon abscess of the liver *per se,* irrespective of other obviously morbid conditions of that organ—*e. g.,* impaired function, congestion, enlargement. To regard secondary hepatic abscess as due to absorption of pus or other morbific matter from ulcerating mucous membrane, or to a true phlebitis, is to take too narrow a view of the relation of liver disease to dysentery; for, if we are to judge by the condition of the bile alone, the liver is diseased (in function, at least) in every case of dysentery (PARKES). The contrast of the results given in the above table, with the result of the cases seen in colder climates, is indeed remarkable. Baly's experience yielded him no abscesses of the liver. Finger, of Prague, dissected 231 cases of dysentery between 1846 and 1848, and found no abscess of the liver. Broussais records seventeen dissections of dysentery in the camp during 1805 and 1806, and no abscesses of the liver. Rokitansky has never found the liver visibly diseased in cases of dysentery; and in China, where dysentery, as a rule, is very fatal to Europeans, the rarity of hepatic abscess is said to have been remarkable (Dr. Wilson in *Records of Hospital Ship "Minden"*).

On the whole, it will be seen that the association of dysentery with hepatic abscess is not equally frequent in all countries, nor in all epidemics. It seems to have been most frequent in the climate of the East Indies, and in the Bombay army especially (MOREHEAD, PARKES). There are some epidemics in Europe in which the hepatic lesion has been observed; *e. g.*, in Dublin, 1818, it was observed in four out of thirty cases (CHEYNE). It would therefore appear that the *poison* which causes dysentery has at some times and places the power of establishing hepatic complication so severe as to lead to abscess; at other times and places it seems to be less virulent.

The spleen and pancreas are sometimes also found diseased; and Mr. Twining notices the former as one of the most fatal complications of dysentery in the East Indies. These viscera are found either enlarged and softened, or enlarged and indurated, the spleen being sometimes the seat of abscess.

Of thoracic viscera, the lungs have sometimes exhibited a great tendency to secondary morbid processes in dysenteric cases. This was especially the case in the dysentery of the allied armies during the late Russian war, where otherwise pulmonic lesions were rare.

The pulmonic lesions associated with the dysenteric process were as follows:—(1.) More or less extensive lesion of the bronchial membrane, the finer ramifications of the tubes being filled with frothy mucus and pus-like exudation, and associated with extensive vesicular bronchitis: there were well-marked spots of lobular pneumonia. (2.) Exudations into the pulmonary parenchyma, chiefly in the form of isolated deposits of considerable density, disseminated through the substance of the lungs. These masses passed into a purulent condition, and microscopically they were composed of broken-up cells, granular matter, and pus-elements.

The last class of conditions which render cases of dysentery complex is the alliance of other disease-processes with dysentery. Such cases are generally of a very protracted duration; and the associated morbid lesions are not only complex from the number of morbid processes developed and the organs attacked, but they are complex from the variety of kind, degree, and extent of the co-existent affections. Many disease-processes may be observed to co-exist in one patient; and such multiplicity of disease-processes tends greatly to multiply the number of the anatomical local lesions, and thereby still more to complicate the case.

Dysentery "is found to complicate readily in all climates with the prevailing fevers." Within the tropics it is frequently associated with *remittent* and *intermittent fevers;* in the geographical region of *typhus fever* it is a most frequent complication, under various circumstances, and becomes capable of propagation from person to person; and, lastly, it is also occasionally complicated with *scurvy.* When dysentery follows upon, or is associated with, intermittent fever, the spleen will frequently become enlarged, indicated in the outset by general anæmia, or splenic cachexia, with a low asthenic type of dysentery.

The scorbutic complication is developed in cases of *dysentery* when the supply of food has been deficient in fresh vegetables, or when it consists in whole or in the greater part of salted meat. Sir Gilbert Blane asserts that the complication has been known to arise among prisoners of war, living entirely on fresh (animal) diet.

"The most terrible instance of suffering from this cause," writes Sir Ranald Martin, "was that of the European portion of the force employed in Ava during the first Burmese war, where they were for six and a half months fed on salt rations, and where 48 *per cent.* perished within ten months, principally by dysentery with the scorbutic state." Such disasters have since been equalled, if not surpassed, by the sufferings of our troops in the camp before Sebastopol during the winters of 1854-55, under the influence of exposure, fatigue, and continued rations of salt meat and green coffee.

There is still another light in which the pathology of this disease requires to be studied, namely, in the

Types and Forms of Dysentery.—These have been variously described as (1.) *the purely inflammatory, acute, hyper-acute,* or *sthenic* form. In this form, while the phenomena indicate acute and severe inflammatory action, there is no tendency to the great depression of the nervous, circulatory, and muscular functions, which gives a marked character to some of the other types of the disease, such as (2.) the asthenic forms. In the *asthenic* forms, besides the depression of the functions just noticed, there is much greater tendency in these forms to spread by infection, or under an epidemic influence. These asthenic forms are sometimes described as *adynamic, typhoid, malignant, bilious, intermittent,* or *remittent,* according as certain phenomena prevail characteristic of these states.

Symptoms of Dysentery.—An ordinary attack generally commences with *diarrhœa;* but in twelve or twenty-four hours disagreeable feelings begin to attend the frequent loose discharges from the bowels. These are irregular pains, commonly called "gripes," along the course of the large intestine, and sometimes described as "shooting," or "cutting." Technically, such symptoms are known as *tormina.* They are momentarily relieved by discharges from the bowels. But after a short time a sense of heat ascends from the rectum, and pain extends to the epigastrium, till the whole abdomen is painful. There is a frequently returning inclination to go to stool: the griping and straining continue without the patient being able to pass anything more than a little bloody mucus. These symptoms are generally aggravated during the night and early morning, and they leave behind them the exhausting sensation that there has always remained in the bowel something which has yet to be discharged. This feeling is technically called *tenesmus,* and ultimately becomes the most striking feature in the case. The acute pain in the abdomen, although it may extend to the iliac regions or flanks, generally concentrates itself at last about the rectum.

The discharges from the bowels are at first scanty, consisting of mucus and blood, or bloody slime, as it is sometimes called. As the disease progresses, the evacuations become more copious, tinged with bile, and carrying off shreds of the exudation thrown out on the mucous surface of the intestine. Hardened balls of fæces, called *scybalæ*, are also sometimes discharged: these, however, are seldom seen in tropical dysentery, and if much feculent matter pass, there is always considerable relief. When the disease is fully established, the discharges exhale an odour different from the smell of fæces, and which is almost peculiar to dysentery, and very offensive. It is important to observe the character of the discharges, and especially as to the relative amount of blood, mucus, and shreds of exuviæ. If the disease advances, besides the constitutional symptoms becoming aggravated, more blood and mucus appear in the discharges from the intestines, together with shreds or large sloughs of exudation, which are often described as pieces of mucous membrane. In very acute cases, going on rapidly to an unfavourable termination, a great change often takes place in the nature of the stools, which become suddenly copious, serous, of a reddish-brown colour, with black spots, attended with a putrid, offensive odour, which pervades the whole house. In the acute dysentery of Lower Bengal the patient is not unfrequently carried off by copious discharges of blood (W. C. MACLEAN). The shreds, however, are not mucous membrane, but, like the dysmenorrhœal membrane which forms on the internal surface of the uterus, the dysenteric slough varies in consistence, thickness, and strength. It may be washed perfectly white in water, and its minute histology shows no character of a mucous membrane. The hardened balls of fæces are much more rarely seen than they have been described to be. When the skin is dry, and of a pungent heat, the tongue furred, and the thirst urgent, the urine scanty and high-coloured, and the pulse increasing in frequency—these are symptoms of increasing danger in dysentery. Throughout the disease there is febrile distress, the nights are passed without sleep, or, when it is obtained, it is in short periods, dreamy and disturbed; and when the patient awakes he is unrefreshed, and his spirits low and desponding. In the majority of cases the disease takes a favourable turn between the sixth and tenth days; the symptoms are then mitigated, the pain ceases, the number of stools diminish, and the flow of urine is restored. On the contrary, if it terminates fatally in this stage, hiccough, vomiting, a small and rapid pulse, and pale sharp features, denote the approach of death. The intellect, however, is perfect, and the patient, often deploring the fate which he sees inevitably to await him, dies after a short agony. In the dysentery described by

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Dr. Clouston some of the patients had ordinary diarrhœa (diarrhœa of irritation ?), from periods varying from two or three hours up to twenty-four hours, before blood appeared in the stools. In some cases there was great pain in the abdomen for twenty-four hours before the diarrhœa set in (evidence of irritation ?). In other cases there was scarcely any pain at any period of the disease.

Dr. Clouston distinguished two classes of cases. "In the first the patient had two or three loose stools, or perhaps had no ordinary stools at all, but at once began to pass glairy mucus, mixed with blood in small quantities at a time, from the bowel. He had no pain, no fever, no want of appetite, and he refused to believe he was ill. This would continue for a day or two, and then the blood would increase in quantity, and the stools would become more frequent. Pain would begin to be felt in the region of the rectum, and the pulse would mount up by ten or twelve beats. For days the patient would be at stool every hour or two, and of course would become weaker. His tongue was then seen to be coated with a dirty yellowish-white fur; but the appetite for such forms of nourishment as milk, strong beef tea, calves' foot jelly made with wine, was still good. Solid food was not relished. The stools would then be seen to be coated with a semi-fibrinous semi-purulent-looking membrane. The tongue would then become clean, and glazed, and beef-steaky; the evacuations became feculent, mixed with pus, the latter element becoming gradually less as the patient advanced in his slow convalescence.

"In the second class of cases the patient had from the first great pain in the abdomen, of a griping kind, a hot skin, and a pulse over 100; the dejections were copious, and frequent, and watery, while they were largely mixed with blood. In many cases there was sickness; in all, loss of appetite. After some days the tongue and mouth would become dry, and parched, and black; the features pinched; the pulse small and quick; and death soon ensued. In some cases the stools would, after a time, become membranous and shreddy, and then purulent, till the patient was more gradually weakened and exhausted. One such case lived six weeks, another two months. In one only of this class of cases (out of seventeen) did the patient recover.

"All the cases had the following features in common:—Bloody stools at first, tending to become purulent; intense fetor of the evacuations during the whole of the disease; no scybala, and great thirst" (*Med. Times and Gazette*, June 10, 1865). These were cases of dysentery caused by the poison of animal effluvia from decomposing human excreta (undiluted) acting on constitutions in which vegetable diet seems to have been deficient (scorbutic), and in whom the nervous power was below *par*.

If the disease proves fatal in the chronic form, the patient generally becomes rapidly altered and prostrated by his sufferings, is strikingly emaciated, and often earnestly prays to be relieved from a life disgusting to himself and entirely despaired of by others. Death begins at the heart.

The patient, on the other hand, may in a few rare instances recover; the local symptoms gradually yield, till his health and strength are ultimately restored, in a moderate degree. Convalescence is slow, rarely complete; and there is perhaps no disease which makes so persistent and pernicious an impression on the human constitution as dysentery.

Causes and Modes of Propagation.—It may be stated, as a general proposition, that there is no country where paludal fever exists in which dysentery is not an endemic and prevailing disease. In the East and West Indies, in China, the Ionian Islands, Gibraltar, Malta, the Canadas, Holland, the coasts of Africa, as well as in many different parts of France, of the Peninsula, of the continent of America, and of the eastern parts of Great Britain, the prevalence of intermittent or remittent fevers and of dysentery is notorious.

This connection is so intimate that a given number of persons being exposed to the action of paludal miasmata—as, for example, a boat's crew sent ashore in a tropical climate—the probabilities are, that of the men returning on board, part will be seized with dysentery and part with remittent fever.

Paludal fever and dysentery, moreover, are not only conjoined in locality, but they often co-exist, precede, or follow each other in the same individual, so that the fever frequently ends in dysentery, and the dysentery in remittent fever. This proof of the common nature of these diseases is corroborated by every writer of any celebrity, and more especially by those who have detailed the diseases of our armies. But dysentery also prevails where there is no other evidence of the presence of malaria. Nevertheless, the evidence in favour of malaria being the common, though probably not the sole cause of dysentery, appears to be much the stronger. It seems also determined that dysentery prevails generally in the inverse ratio of the intensity of paludal fever. In Jamaica, for example, when the white troops suffered in the large proportion of 91 *per cent.* annually from paludal fevers, the cases of dysentery were to those of fever as one to nine: while in the Madras presidency, when the troops suffered from fever in the much less ratio of only 30·25 *per cent.* annually, the cases of dysentery were to those of fever as forty-seven of the former to thirty of the latter. It appears that dysentery is less common in the hotter than in the colder months, or arises under circumstances less favourable to vegetable decomposition. Thus in India and China it is from the middle of November to the latter end of February, or when remittent fever changes into intermittent, that dysentery greatly prevails. It seems to be recognized by those most competent to judge, that there is a directly exciting action of malaria quite apart from that indirect action of undermining the general health, the importance of which as a predisposing cause cannot be over-estimated (GRANT, W. C. MACLEAN).

Our knowledge of the predisposing causes is derived from what principally occurs in the military and naval service; and from the sufferings of the troops we learn that exposure to the night air, to wet, or to fatigue, together with the intemperance and often improper diet incident to the life of a soldier, especially on active service in the field, have at all times been found to be conditions powerfully predisposing to dysentery.

The effects of *salt* diet in the production of dysentery being less known than the other predisposing causes, it may be as well to state that, by an experience of twenty years in the West Indies, it has been determined that in the Windward and Leeward Command, when the rations issued to the troops consisted of salt provisions five days in the week, the mortality from diseases of the stomach and bowels among the officers was as two to four *per cent.*, while that among the soldiers was as 20·7, or a tenfold ratio. On the contrary, in Jamaica, when salt provisions were issued to the troops only two days in the week, the mortality from the same diseases approximated so nearly between these two ranks as to be almost an equality. And corresponding facts to these have been observed in Gibraltar, on the coast of Africa, and at St. Helena. The Sierra Leone Commissioners on the western coast of Africa, who investigated this subject on the spot, were of opinion that the large proportion of salt rations mainly contributed to the sickness and mortality from diseases of the stomach and bowels in the form of dysentery and diarrhœa; and the following statement, given by the late Sir Alexander Tulloch in his Statistical Reports (page 11) on the sanitary condition of the troops in the West Command, shows the marked reduction which took place in the deaths from this class of diseases subsequent to the introduction of fresh meat diet; the mortality being reduced to a *tenth* part of its former ratio:—

PREVIOUS TO ALTERATIONS IN RATIONS.						SUBSEQUENT TO ALTERATIONS IN RATIONS.					
Year.	Mean Strength.	Dysentery and Diarrhœa chiefly.		Ratio per 1,000 of Mean Strength.		Year.	Mean Strength.	Dysentery and Diarrhœa chiefly.		Ratio per 1,000 of Mean Strength.	
		Admitted.	Died.	Admitted.	Died.			Admitted.	Died.	Admitted.	Died.
1825	571	235	32	411	56	1828	232	139	1	600	$5\frac{1}{10}$
1826	471	256	26	543	56	1829	114	50	—	439	
1827	345	209	13	606	38	1830 to 1836	42	22	1	524	
Total, ..	1387	700	71	Average. 505	Aver. 51						
						Total, ..	388	211	2	Average. 543	Aver. $5\frac{1}{10}$

In the navy the same effects of ill-regulated diet have been observed, and the good effects of a change. "In 1797," says Dr. Wilson, "the victualling (of the navy) was changed, greatly improved, and consequently immediate to the change the health of the seamen improved strikingly. *Scurvy, typhoid fever, dysentery,* and *ulcer,* which, up to the period of the change, had produced great havoc, became comparatively rare in occurrence and light in impression," and, it may now be added, are hardly known except by name.*

An insufficient diet was the main predisposing cause of the dysentery which prevailed in London at the Penitentiary, Millbank, shortly after its completion. This prison is built on a marsh below the level of the Thames at high-water, the river being banked out by a narrow causeway. As long as the prisoners were allowed a full and ample diet, they appear to have resisted the action of the paludal poison, and to have enjoyed good health. No sooner, however, was the quantity and quality of their dietary lowered than dysentery of a very fatal character broke out, and made it necessary to clear that establishment for a time of all its inmates. In the dysentery so well described by Dr. Clouston (already frequently referred to), the predisposing cause seems traceable to a diet deficient in fresh vegetable food, in constitutions of feeble nervous power, and aged, weak, and paralyzed persons, exposed to the poison of animal effluvia, in the form of decomposing and undiluted human excreta, as an exciting cause of the disease. The morbid appearances were characteristic of the scorbutic form of dysentery; and the premonitory symptoms were similar to those described by Dr. Barker (and referred to at page 416 of this volume) as peculiar to poisoning by sewage gases. Such cases were not contagious.

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* As Dr. Christison justly observes, the salt meat of military and naval rations is not the same as the salt meat of civil life. The former is highly salted, in order to keep for two or more years in every climate. Its nutritive value is thus greatly overrated, and its nutritive constituents are still further diminished by the process of washing out in water before it can be eaten. Thus, besides the irritant effects of the salt diet in producing dysentery, another element exists as a cause of disease—namely, the insufficient nutrition which the salt ration diet is able to impart.

From the MS. notes of Dr. Alexander Grant regarding dysentery in India, to which I am kindly permitted to refer, I find that he, too, is of opinion that sewage miasm (animal effluvia poison?) may be a direct exciting cause of diarrhœa and of dysentery, constituting one form of the disease.

In cachectic states, whether from malaria, syphilis, scorbutus, the exhaustive effects of heat long continued have a markedly predisposing influence in favouring the production of dysentery; and in the treatment of the disease the existence of any such cachexia must be inquired into, and if possible counteracted.

There are few facts to enable us to determine the proportions in which the different ages suffer from dysentery, but the returns of the troops from the Mauritius show that the mortality from this disease falls principally on soldiers advanced in life (Tulloch).

Forces in the Mauritius.	Age.			
	18 to 24.	25 to 33.	33 to 40.	40 to 50.
Aggregate strength of seven years,	3892	5361	1215	300
Died of Dysentery,	26	63	24	8
Ratio per 1,000 of mean strength,	6·7	11·8	19·7	36·6

Besides unwholesome solid food, water of an impure kind and from an impure source favours the development of dysentery. Drained from swamps, and used for drinking and cooking purposes, as it was on the Chinese coasts, it exerted a marked injurious influence both in exciting and in maintaining the disease. In connection with impure water, the reader is requested to refer to what is said afterwards under the head of "Parasitic Diseases;" and especially under "*Distoma hæmatobium.*"

Many other predisposing causes favour the development or propagation of the disease, especially amongst soldiers in active service—namely, long marches in hot weather, bivouacking at night in the open air (often extremely cold both absolutely and relatively to the day), want of sufficient clothes and bedding, may be mentioned as the chief.

It does not seem to be so clearly understood as it ought to be, that dysentery is contagious, or rather that it is capable of being propagated from person to person. Being a frequent complication or concomitant of contagious fevers, it has been believed to inherit similar contagious properties. In the severe form of dysentery, for which the old Infantry Barracks of Secunderabad, in the Deccan, have long been notorious, it has been observed that men, labouring under other diseases, who happened to be exposed to the putrid effluvia of the excretions of dysenteric patients were often severely affected by the disease (W. C. MACLEAN). There is, therefore, good reason to believe that the exuviæ of dysenteric patients, as passed by stool, may, like those of typhoid fever, propagate the disease; and the observations of Budd and Goodeve give support to this view.

Prognosis.—The prognosis in dysentery depends much on the country in which the disease occurs, and on the combination of circumstances predisposing to the disease, not less than on the form or type which the disease may assume. In hot climates it is calculated that the deaths vary from one in nine to one in twenty; and on actual service the chances of recovery are much diminished. In all returns, however, the total deaths recorded give a faint idea and inaccurate representation of the real mortality resulting from dysentery. If it were possible to trace out the men who were invalided from the army and navy services from the effects of this disease, it would be found that the

1–9 To

mortality is very much greater than is represented by tabular returns. It is a malady which, once fairly engrafted on the system, never leaves it till life itself becomes extinct (Bryson, and others). It is sometimes also insidious in its mode of attack and progress; and there is such a desire, on the part of soldiers especially, to avoid the restraints of hospitals, that the disease is sometimes beyond the power of medicine before coming under treatment, especially in tropical commands (Tulloch). In the cases described by Dr. Clouston as those of the second class (see page 618 *ante*), the chances of recovery are hopeless from the first, and all complications with scorbutus are very unfavourable. There may be diseases of a more rapidly fatal character, but there are few which entail so great an amount of suffering. When once the disease has passed into the chronic form, it slowly, but not the less surely, continues, by a most loathsome process, to exhaust the vital energies, until death relieves the patient of an existence rendered almost intolerable by pain, debility, and the offensive nature of the discharges (Bryson).

Diagnosis.—It is difficult, perhaps impossible, in the first stage, to distinguish dysentery from diarrhœa; but the blood, the number of the stools, and small quantity of fæcal matter passed, will, in times when dysentery is prevalent, indicate the true nature of the disease.

Treatment.—After what has been written regarding the nature and the causes of dysentery, it is the obvious duty of the physician to direct his attention, in the first instance, to the *prevention* of the disease. He must inquire especially as to the conditions of the diet, that it be sufficient as to its animal and vegetable elements, and of good quality. Next, he ought to insure the means of detecting the disease early—for time is of the greatest importance in its cure and prognosis—and especially by removing the patient, if possible, from the sphere of action of any of those predisposing or exciting causes as have been noticed; and also to see that his surroundings are free of all those circumstances which co-operate in aggravating the disease, the chief of which are overcrowding, bad ventilation, bad food, exposure, intemperance. With regard to medicinal agents:—“He who would treat this disease with success,” writes Sir Ranald Martin, “while he shuns exclusive means, must assign to each remedy its proper value. Blood-letting, sudorifics, and purgatives, constitute the most universal remedies, and in simple uncomplicated dysenteries they will prove all-sufficient. But when the abdomen is tumid, and there is pain in the liver, or in any other region, while the nature of the discharges indicates advancing inflammation, calomel, conjoined with sudorifics, and repeated to meet the occasion, will powerfully aid the curative effect through its influence on the depurative functions—on the circulation, by unloading, jointly with purgatives, the gorged vessels of the abdominal organs—on the blood and on secretions generally—and on the very sudorific function which we wish to excite. While calomel is a most powerful agent when used judiciously, as an aid to blood-letting, pushing it to the extent of ptyalism is by no means to be recommended; nor should mercury in any shape be used in *adynamic* forms of the disease, in scorbutic dysentery, or in poisoning by animal effluvia, in the splenic cachexia, nor in states of anæmia, for in all these conditions of the system its actions are most injurious" (see footnote by Dr. Maclean).

Ipecacuanha was formerly, and still is, much in vogue as a remedy in the treatment of dysentery; but, although highly useful in some conditions, it is not to be regarded as a specific in all forms of the disease. There is no exclusive plan of treatment applicable in all cases. Admitting, therefore, the necessity of occasionally employing general and local bleeding, and also calomel as a laxative, in cases of hepatic complications, we have beyond this only the general principles to guide us of allaying irritation, and of controlling, if possible, the diarrhœa; and the best general rules that we possess are those recommended by Sir James M'Grigor to be adopted in the army (acknowledged by him to be derived from Dr. Somers); those given by Sir Ranald Martin, already detailed; and those by Professor Maclean, about to be noticed.

"In acute cases," says Sir James M'Grigor, "we commenced by copious venesection, and immediately afterwards gave twelve grains of compound ipecacuanha powder every hour, which was repeated three times, with plenty of barley-water, and profuse sweating was encouraged for six or eight hours. A pill of three grains of calomel and one of opium was administered every second night, and in the intervening day two drachms of sulphate of magnesia dissolved in a quart of light broth. The venesection was repeated, while the strength and pulse permitted it, until the stools were free, or nearly free, from blood. Dover's powder as a sudorific was always given after the blood-letting.

"In cases where the pains were excruciating, and attended with tenesmus, the warm bath gave instantaneous relief. This plan being steadily persevered in for a few days, the inflammatory diathesis of the intestinal canal, which had excited symptomatic fever throughout the general system, was found gradually to be relieved, and paved the way for returning health. In this stage gentle tonics, with light nourishing diet cautiously taken, and at first given in moderate proportions, were administered with the happiest effects.

"The disease was not unfrequently cut short by this method. If, however, the disease became chronic, a different mode of treatment was pursued, and not unsuccessfully, if the disease had not been of long duration, the intestinal canal not much disorganized, or not complicated with other diseases.

"The first indication in this chronic state was to relieve the tenesmus and procure easy stools, and with this view ipecacuanha was given, sometimes with calomel, sometimes without it. The neutral salts were given, or castor oil, jalap, and various other medicines of the same class. The second indication was to relieve the number of the stools, and to restore tone to the alimentary canal. With this view Dover's powder, the compound powder of chalk with opium, astringents, and demulcents, with aromatics, were given, occasionally interspersing laxatives, and obviating particular symptoms as they occurred. Lastly, an infusion of bitters was given, to restore tone to the relaxed intestine."

In addition to these remedies, Sir James M'Grigor states that the *balsam of copaiba*, an *infusion of calumba*, *hæmatoxylon*, *kino*, and *catechu*, assisted by *opium* occasionally, gave much relief, and also the administration of a variety of enemata, and especially one of a strong solution of *superacetate of lead;* while in cases of liver affection, he adds "that friction of the abdomen with mercurial ointment gave the least irritation, and at the same time produced less debility."

Such is the statement of the practice pursued in dysentery during the Peninsular war, on a scale whose magnitude has seldom been surpassed even in modern times. If, however, we look to the returns, we find it highly probable that not more than two out of three of those attacked ultimately recovered.

Pulvis Ipecac ʒi
Aq ℥xvi.

The bark of the root of *calotropis gigantea* (or *mudar*) has been recently used in India, and found to be an excellent substitute for *ipecacuanha*. It is used in doses of a scruple to a drachm, is a reliable cholagogue, and sedative to the muscular fibres of the intestine, rapidly allaying pain, tenesmus, and irritation (Durant *Ind. Med. Jour.*, May, 1866).

In general, the dysenteric patient is not admitted into the hospitals of our large towns until the disease has passed into the second stage, and there is no class of disease which then offers so few chances of recovery. On the Continent the neutral salts and mild purgative medicines are highly spoken of; but it is difficult to understand how these substances, having no specific power over the disease, can be beneficial in a highly ulcerated state of the intestine. Of all purgatives, however, two ounces of an infusion of *ipecacuanha* (in the proportion of one drachm to a pound of boiling water), combined with five to ten drops of the *tincture of opium*, and given every six or eight hours, appears to be the best; but the disease, though mitigated, is seldom cured by these means. Vegetable tonics, containing *tannin*, as *kino*, *hæmatoxylon*, or *catechu*, however prepared or combined, give temporary relief, but are ultimately inefficient. When the disease has fairly gained the ascendant, it does not appear that one remedy is better than another. Dr. Bryson writes that he has seen all the astringents, both mineral and vegetable, mercury, both internally and externally, with many other medicines, tried without any benefit; but there were some means which were useful in relieving the more urgent and distressing symptoms, and, as it were, in smoothing the path to the grave. Amongst these he mentions *a well-regulated farinaceous diet*, *opium suppositories*, *anodynes*, *astringent injections*, minute doses of *calomel* in combination with *opium*, *cascarilla*, *resinous astringents*, and the application of *leeches to the rectum* when tenesmus was distressing, or over the course of the colon when there was deep-seated pain. An injection of warm starch (two ounces), with laudanum in it, will often give great relief. As much nourishment should be given in a liquid form as the patient can be got to take. Milk boiled with flour should be taken as often as possible, night and day. It should be taken cold, even with ice, and in small quantities at a time; and small pieces of ice not only allay~~s~~ sickness and nausea, but seem~~s~~ to soothe the irritability of the intestines. Strong beef tea or Liebig's extract of flesh are most useful.

The value of a change of climate, as a curative measure, is forcibly illustrated by Dr. Bryson. He says that the crews of vessels improved in health almost immediately after quitting the station where dysentery prevailed.*

Where sewage is applied to the soil by surface irrigation, it ought to be diluted largely with water, and deodorized by *carbolic acid.*

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* My friend and colleague, Professor Maclean, writes me the following note on the treatment of dysentery, the result of his extensive experience in India and China:—"The first thing to bear in mind in the treatment of tropical dysentery is, that the appearance of strength in the patient, given by the acuteness of the symptoms, is delusive. Under the use of strong antiphlogistic treatment the strength of the patient is apt to fail suddenly, and this is often the case even when the treatment has been more conservative in its character. It was once the custom in India to deplete freely in this disease, either by a general bleeding or by the repeated application of leeches; but the most judicious and successful practitioners in India rarely bleed now, *even in the most sthenic forms of the disease,* and confine the use of leeches within the narrowest limits.

"**Mercury.**—It is certain, too, that mercury is yearly less and less used in India than it was, and there is much evidence to show that a corresponding reduction in the mortality of the disease has been the result. The objections to its use are numerous,—it entails great suffering on the patient, if pushed to ptyalism, aggravating his miseries, and too often permanently injuring his constitution; it has no specific action on the disease, and its cholagogue effects can be attained by remedies which are not open to such objections as can be brought against mercury. (With regard to its cholagogue effects, grave doubts are thrown by the experiments of Dr. George Scott, referred to at the footnote of page 165 by the author.) In sloughing dysentery it is followed by the worst results; and the observations of clinical observers in India have shown that individuals under the influence of mercury are not only not exempt from attacks of the disease, but are peculiarly prone to be affected by it. This is the case in a very marked degree in Asiatics (MOREHEAD and MACLEAN).

"**Ipecacuanha.**—This remedy has long been used in South America in the cure of dysentery,—whence, indeed, it came. It was much used in India until the mercurial notions of James Johnston prevailed. It was again used by Dr. Twining, of Bengal, by whom it was strongly recommended, and also by Dr. Mortimer, of Madras. Twining combined it with blue pill and gentian, and used it chiefly in small and oft-repeated doses. In South America the practice has always been to administer an infusion of the bruised root,—ʒij. being infused over night in ℥iv. of water, and given early in the morning. In Peru it is given in doses of ʒss. to ʒi. of the powdered root in a little syrup and water. This practice of giving ipecacuanha in large doses has lately been revived in India with encouraging success, and, I believe, the greatest number of cures. It appears to act on the portal capillaries, and on those of the mucous membrane of the bowels, and to determine powerfully to the skin. *It is usually given in doses of half a drachm or a drachm, either in pills*

DIARRHŒA.

LATIN, *Alvus soluta;* FRENCH, *Diarrhée;* GERMAN, *Durchfall*—Syn., *Diarrhöe;* ITALIAN, *Diarrea.*

Definition.—*A frequent discharge of loose or fluid alvine evacuations, without tormina or tenesmus.*

Pathology.—This affection is rather a consequence or a symptom of certain pathological states than of itself a disease; yet, as there are many agents, both of a moral and physical nature, that act thus upon the human body; and as there are also many known morbid poisons which bring about this state, it merits some notice in the class of diseases now under consideration. It is a morbid action of function, rather than any disease of structure, being

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or bolus, or suspended in mucilage, according to the fancy of the patient. It is advisable to give an opiate half an hour before, and to withhold all drink for some hours. Unless there be hepatic complication, it seldom happens that much vomiting is caused by these large doses; on the contrary, they are often tolerated when smaller doses are rejected. The dose should be repeated in about six hours. A sufficient interval should be allowed to intervene between the doses of ipecacuanha to admit of the patient being sustained by nourishment adapted to the stage of the disease. I need hardly add a caution not to press the remedy too far.

"Dr. Cornish, of the Madras army, has shown from official documents that the mortality from acute dysentery in Southern India under mercurial treatment was 7·1 *per cent.* Since the general introduction of ipecacuanha in full doses it has fallen to 1·3. Dr. Ewart, of Bengal, has shown that equally good results have followed the same system in that Presidency. During the forty-two years from 1812 to 1853-54 the mortality among European troops in the Bengal Presidency amounted to 88·2 in the thousand. But during 1860, when large doses of ipecacuanha were administered, the mortality was only 28·87 in the thousand. NB

"Great credit is due to Mr. Docker, of the 7th Royal Fusileers, for re-calling practitioners to the use of this invaluable remedy, (*Vide* Grant's *Annals of Military and Naval Surgery*, vol. i.)

"In no disease is early treatment more necessary than in dysentery, and I believe that, if conducted as above, except in the malignant and 'putrid' forms, we may look for good results in a large proportion of cases. Turpentine epithems and fomentations should be diligently used, and the patient's strength should be supported by nourishment of a bland kind, suited, in degrees of nutritive value, to the stage of the disease.

"In the scorbutic form we have a valuable remedy in the *Bael fruit*, when procurable. This fruit contains a large quantity of *tannin*, with vegetable mucus, a bitter principle, and a vegetable acid. It is much used in Bengal; and in the scorbutic form I have seen it successful when all other measures have failed (See note on Bael fruit, by Dr. Grant, in *Indian Annals*)."

unassociated with any definite specific lesion of vital parts. It may be regarded generally as the immediate result of unwholesome diet, excess in food or drink, cold, wet, fatigue, and exposure, and various functional derangements of the biliary and gastro-intestinal apparatus.

Symptoms and Forms of Diarrhœa.—Nosologists have generally divided the disease into varieties founded on the different states of the discharges; but as these do not depend upon definite pathological states, the classification is of little use. Nevertheless, the state of the discharges furnishes important indications in the treatment of the disease. The most common appearances are due to the predominance of fluid feculent matter, or to bile, mucus, serum, chyle, or where undigested masses of food pass unchanged, giving rise to what is termed a "lientery." But the discharges are more often of a mixed kind, made up of several of those states.

The idiopathic forms of diarrhœa which require notice are,—(1.) *Diarrhœa of irritation;* (2.) *Congestion, or inflammatory diarrhœa;* (3.) *Diarrhœa with discharges of unaltered ingesta* (*lientery*).

(1.) *Diarrhœa of Irritation.*—This form comprises most of the cases denominated *feculent* by authors. It is induced by stimulating or irritating substances received into the stomach, excesses in eating or drinking, or even by a small quantity of unwholesome food, or by poisoning from animal effluvia and from certain mineral poisons, or what constitutionally disagrees with the patient. In infants it is often brought on by unwholesome conditions of the milk, such as the persistence of *colostrum* in it. Nausea, with severe griping pains before each evacuation, a foul, loaded tongue, copious feculent stools, watery, mucous, or bilious, and becoming frothy, are the phenomena of this form of diarrhœa.

(2.) *Diarrhœa from Increased Vascular Action.*—This variety is caused by whatever induces a greater flow of blood to the intestinal mucous surface, and at the same time lessens or obstructs the cutaneous elimination of fluids; the application of cold to the cutaneous or pulmonary mucous surfaces, or to both at once; cold acid drinks, or ices taken when the body is overheated; suppression of perspiration or of accustomed discharges; checked menstruation or lochial discharge.

The evacuations are watery or serous, with mixed feculent matter, and exhibit every shade, from a dark brown, greenish-brown, to a pale greyish or whitish colour; and they contain, in some cases, pieces of thick gelatinous mucus, or thin, glairy, and stringy mucus. In other instances, whitish, albuminous flocculi are abundant in the stools; and in a few instances large membranous or albuminous shreds or flakes present a mould of the internal surface of the gut.

In addition to the symptoms noticed in the former variety, there is, in this form of diarrhœa, a dry, harsh skin, with increased temperature of the trunk, a flatulent state of the bowels, a small, frequent, constricted, but soft pulse, a furred or loaded tongue towards its root, with red edges and point, and scanty, high-coloured urine. In infants this variety is known as the "watery gripes," and often precedes fatal exhaustion in them.

(3.) *Diarrhœa with Discharges of Unaltered Ingesta.*—This is essentially an atonic form of diarrhœa, and very different from the last variety. It corresponds to the "*diarrhœa lienterica*" of the older authors. The most marked and characteristic phenomena which attend the disease are due to the almost total suspension of the digestive, assimilative, and absorbent functions, the *egesta* often differing but little in appearance from the *ingesta*. Such a form of diarrhœa occurs more frequently in children before the period of the second dentition than at later periods. It is frequently the consequence of previous inflammatory irritation of the alimentary mucous surface, and disease of the mesenteric glands. It seems as if, in this variety, the stomach had lost its tone or vital energy, as well as the mucous membrane of the alimentary canal; and it no doubt results, in the first instance, from indigestion. This was a frequent form of diarrhœa amongst the soldiers in the Crimea, as observed by Dr. Lyons; and the soldiers themselves observed it, and were in the habit of saying, "It is of no use eating, as our food passes through us in the same state as it goes in." The appetite is usually voracious; and when this form of diarrhœa continues long, the debility becomes extreme; and when death takes place, it is from stupor and exhaustion.

In a practical point of view, these are the principal varieties of idiopathic diarrhœa which require to be distinguished; and the diagnosis of the form of diarrhœa symptomatic of the invasion of other diseases are noticed under the special diseases of which they form a part.

Treatment.—For practical purposes, the treatment of these three forms of idiopathic diarrhœa may be founded on the following indications—namely, *first,* that in which the *tongue is clean,* the pulse quiet, and all constitutional re-action absent; and, *second,* that in which the *tongue is white* and coated, the pulse accelerated, some fever present, and the pain or soreness constant and increased by pressure. The stools in either case may be black, green, white, or mixed with blood indifferently.

When the *tongue is clean,* if the disease be quite incipient, the usual practice is to give one dose, consisting of an opiate, combined with a gentle cathartic. The form may be *one grain of opium,* combined with a *drachm of compound rhubarb powder,* or combined with *five grains of calomel.* To remove any offending matter that may be present, their action may be aided by castor oil, or a saline cathartic, such as a seidlitz powder. Sometimes it may be advisable to omit the opium, and to combine antacid remedies with the purgative, as in the following prescriptions:—

℞. Sodæ Bi-carbonatis, Hydrargyri cum cretâ, ā ā gr. ii.—ad gr. v.; Magnesiæ Carbonatis, gr. iii.—ad gr. vi.; Pulv. Rhei, gr. v.—ad gr. viii.; *misce.*

Or:—

℞. Sodæ Bi-carbonatis; Pulv. Rhei; Pulv. Calumbæ, ā ā gr. iv.—ad gr. vi.; *misce.*

The administration of such a powder may be repeated at intervals—twice or thrice a day; and ipecacuanha in small doses (a quarter or a sixth of a grain) may be sometimes advantageously combined with each dose. These medicines having produced their intended effect, others more distinctly astringent may be administered if the diarrhœa persists. In many cases a drachm of *syrup of poppies* after each stool is sufficient. In severe forms of the disease a scruple to half a drachm of the
gr xx – xxx *compound chalk powder,* in some aromatic, such as peppermint or cinnamon water, every four or six hours, is an excellent remedy; and these medicines may be used whether blood be or be not in the stools. If the opiate and aromatics contained in the above medicine should prove insufficient, it may be necessary

to add to each dose some of the class of pure astringents, as a drachm of the *tincture of kino*, or of *catechu*, or *hœmatoxylon*, or of *iron*.

There are cases of diarrhœa with a *clean tongue*, which will not yield to opiates, astringents, or stimulants, either singly or combined, and which probably depend on a want of tone in the intestine; and in these cases *five grains of salicine* every four or six hours have often stopped a diarrhœa that appeared fast hurrying the patient to his grave. *Tincture of the sesquichloride of iron* is similarly useful, in doses of five to ten minims.

When diarrhœa is accompanied by a *white furred tongue*, (2) together with pain and soreness, it is necessary to give opiates, combined with some mild purgative. Thus, *half a drachm to a* gr 30–60 *drachm of Epsom salts* with a *drachm of the syrup of poppies*; or *fifteen minims of the tincture of hyoscyamus*; or, in severe cases, with *three to five minims of tincture of opium*, every *four* or *six* hours, are remedies on which, as a general principle, we may very confidently rely. In other cases, *rhubarb, castor oil*, or any other *mild purgative*, may be substituted for the Epsom salts. In cases of diarrhœa accompanied by vomiting, *a drachm of syrup of poppies alone*, repeated every half hour, or every hour, for two or three times, may quiet the stomach, and enable it to bear the other remedies; or soda-water, or the effervescing draught, with a table-spoonful of brandy, with or without a few minims of tincture of opium, often remain on the stomach when everything else is rejected.

Most practitioners lay great stress on the colour of the stools, and the necessity of correcting the supposed morbid states of the liver; but the various colours of the stools are in many instances caused rather by morbid secretions from the surface of the mucous membrane of the intestines than by any defective state of the bile in the gall-bladder; and the conclusion from this consideration is, that, in simple diarrhœa, mercury (which is so often given in a routine way) in any form is either unnecessary or injurious in the majority of cases, except as a purgative. In a smaller number, however, it is sometimes necessary, and more especially in children under four years of age. One general rule may be acted on in the cure of diarrhœa, which is, that in the adult, whatever be the form of the diarrhœa, if the stools be dark at first, and then become light-coloured, purgative medicines are no longer beneficial, and in no instance ought they to be continued longer than is sufficient to remove any irritative substance accumulated in the alimentary canal.

Sulphuric acid, in doses of the officinal diluted drug, of twenty to thirty drops, with water simply, or combined with the compound tincture of gentian, has been found a useful remedy. The sulphuric acid may be alternated with the nitro-muriatic acid, and prescribed in a similar manner.

The dietetic treatment should be limited to slops, puddings, and white fish boiled, and the drink to weak brandy and water, which acts locally as an astringent, and generally as a diffusible stimulus.

MALIGNANT CHOLERA.

Latin, *Cholera pestifera*—Idem valent, *Cholera serosa, Cholera spastica, Cholera asiatica;* French, *Choléra asiatique;* German, *Cholera nostras*—Syn., *Cholera, Asiatische Cholera;* Italian, *Colèra morbus.*

Definition.—*A disease essentially of miasmatic origin, developed under certain atmospheric and terrestrial local conditions in Europe, Asia, and America, and capable of being propagated or diffused, to a certain extent, over the surface of the earth, through the atmosphere, or in some other way, and also by means of human intercourse between the healthy and the sick. It is characterized in many (but not in all) cases by premonitory diarrhœa, sudden muscular debility, tremors, vertigo, occasional nausea, and spasmodic griping pains in the bowels, depression of the functions of respiration and circulation, and a sense of faintness; copious purging of serous fluid and sometimes blood, succeeded by vomiting and burning heat at the stomach, coldness and dampness of the whole surface of the body, coldness and lividness of the lips and tongue, cold breath, a craving thirst, a feeble rapid pulse, difficult and oppressed respiration, with extreme restlessness (a state expressed in physiological language by the term* "anxietas"), *suppressed urinary secretion, blueness of the entire surface of the body, a sunken and appalling countenance, a peculiarly suppressed voice, a peculiar odour from the body, partial heats of the præcordia and forehead—fatal collapse, or re-action and secondary fever. Under conditions favourable to its development it often becomes epidemic.*

Pathology.—During recent years volumes have been written on the nature and causes of cholera; and the description of it which I here give is chiefly drawn from the writings of men who, while they have been themselves original observers of the disease throughout an extensive experience in this country, in India, and in the north of Europe, have since been the able expositors and philosophical critics of the numerous official, original, and independent scientific accounts of it which have been lately given to the world.

The remote cause of cholera is unquestionably a poison; and that it should spread over countries which, in respect to climate, soil, geological formation, and also as to the moral and physical habits of the population, are the most opposite to those where it first originated, is only explicable by the hypothesis of its propagation by a specific poison.

One doctrine, therefore, now very generally accepted regarding the pathology of cholera, is that a poison *has been absorbed*, and infects the blood;—that, after a longer or shorter time, it produces a primary disease of the blood;—that it undergoes enormous multiplication in the living body of the cholera patient, as a result of the morbid process so established; and that changes are induced in the function of respiration directly consequent upon this alteration of the blood by the poison.

> "Whose effect
> Holds such an enmity with blood of man,
> That, swift as quicksilver, it courses through
> The natural gates and alleys of the body;
> And, with a sudden vigour, it doth posset
> And curd, like eager droppings into milk,
> The thin and wholesome blood."—HAMLET, Act I., Scene V., line 64.

So wrote our greatest English poet three hundred years ago; and by such characters it has been ably shown by Dr. Wm. Budd, of Bristol, Sir Thomas Watson, and others, that cholera identifies itself with that group of contagious poisons which give rise to acute general diseases. It is this multiplication, and the disturbance to the vital functions, which in each case constitutes the disease and destroys life. In small-pox the work of reproduction is seen in results directly appreciable to the eye. An impalpable speck of small-pox virus inserted into the skin may produce a disease which, in the course of a few days, issues in the development of a new stock of the same virus, sufficient in amount to inoculate myriads of other persons with small-pox; and although the fact may not yet be open to evidence so precise, yet the circumstantial evidence is conclusive which shows that, in any case of Asiatic cholera, its specific poison is multiplied in a ratio at least as great.

(4 But another doctrine is now also making progress—namely, that the blood is only *secondarily affected*, and that *primarily a poison* (of fungoid? nature) makes its way to the intestinal mucous surface, and there develops itself, to the rapid annihilation of the powers of life. If such a doctrine proves true, it will cause this disease to be classified amongst parasitic poisons.

A peculiar character regarding the cholera poison which is very necessary to be remembered when we try to interpret the varied anomalies associated with local outbreaks, *is the tendency of the poison, when in a moist state, to rapid spontaneous decomposition and extinction* (Budd, *Associat. Journal*, 1854). This characteristic property accounts in some measure for the rapid subsidence and short duration of particular epidemics; and it does not seem that the poison can long subsist in the common conditions of the English climate. In India, on the contrary, where the disease may be said to have had its birth, the atmospheric conditions appear to be more favourable to the preservation of the powers of the poison—partly from the nature of the temperature, partly from the climate being such as rapidly to dry up the poison-holding material—so that its essence is unimpaired.

The phenomena resulting from the changes in the blood in cholera are the proper and distinctive symptoms of the disease; and the term "*algide*," first used by the French pathologists, very properly designates one of its most remarkable and constant symptoms—namely, the diminution of animal heat. The sensation of cold communicated to the observer has been compared to that experienced on touching a moist bladder or the skin of a frog. The algide symptoms, therefore, essentially constitute the characteristic phenomena of this disease. In proportion to them is the malignity and rapidity of the case. They afford the only measure of its severity, and from them only can a correct prognosis be formed. The vomiting, purging, and cramps are considered as non-essential phenomena; for authentic cases of cholera are on record entirely divested of these symptoms; and the suddenness with which the poison sometimes extinguishes life is extremely remarkable. Instances of death taking place in two, three, four, or six hours, are by no means uncommon. When the disease broke out at Teheran, in May, 1846, Dr. Milroy states that those who were attacked dropped suddenly down in a state of lethargy, and at the end of two or three hours expired, without any convulsions or vomitings, but from a complete stagnation of the blood. In Bulgaria, during the outbreak of cholera in the allied armies, in the summer of 1854, the rapidly fatal character of the early cases was notorious. Such records confirm the views developed by Drs. Parkes, Johnson, Sir Thomas Watson, and others, as to the essentially poisonous nature of the disease, and the very rapid depressing influence of the poison. It is plain, also, that a poison so powerful, so suddenly overwhelming all Nature's efforts at resistance, does not allow time, in many cases, for any secondary or specific actions to be set up.

After death, during collapse, the following lesions have been noticed:—The follicular structure of the intestinal canal has been found to be swollen, and the intestine filled more or less with a turbid, inodorous, semi-diaphanous fluid, usually compared to a thin starch or rice-water, the remains of that immense secretion which has taken place during life, and which, being tested, has been found sometimes acid and sometimes alkaline. It is found in its most unmixed condition in the small intestines. It consists of a thicker and thinner portion, and it appears to be the latter which chiefly constitutes the "rice-water" stools, which may be passed off without admixture of the thicker substance. A layer of greyish mucus has also been found coating the whole of the mucous membrane of the alimentary canal, but without a trace of bile, although the gall-bladder is usually filled with that fluid. If the first stage has been prolonged, the mucous membrane of the alimentary canal is of a livid colour, and in some instances has presented a mammillated appearance, caused by an enlargement of the tubular glands, from which a white opaque fluid can be squeezed out, and the mammillated appearance effaced.

The liver, the spleen, and the kidneys have in general been found gorged with blood as to their veins, and the veins of the kidneys are quite as visible as from "contracted mitral-valve" disease (SUTTON); and this engorgement extends even to the bones, which, Louis says, appear as if the animal had been fed on madder. The capillary vessels were empty. Professor W. T. Gairdner considers this state the natural appearance in persons dying of such very acute diseases as do not remove the colouring matter from the blood (*Edin. Med. Journal*, July, 1849). The bladder is contracted and empty. The membranes of the brain and cord are in general congested, and the substance of the brain dotted with more *puncta cruenta* than usual. The most common appearances in the lungs are the presence of blood in the ramifications of the pulmonary arteries, chiefly or solely; the collapse and the deficient crepitation—arising from the more or less complete absence of air in the air-cells and blood—in the minuter capillaries, and from the approximation of the molecular parts of the pulmonary substance. The ultimate tissues of the lungs are pale and bloodless. In other cases there is more blood in the minute structure, a corresponding dark colour of the lung, and a variable amount of frothy serum. The right side of the heart and the pulmonary arteries were generally filled, and, in some cases, distended with blood; the left side and aorta were generally empty, or contained only a very small quantity of dark blood; the left side evidently had received little or no blood, but had continued to contract, in some cases even violently, on the last drop of blood which had entered it (so-called "concentrical hypertrophy"). It was curious, also, to notice that the icy coldness of the body in the stage of collapse passed away after death, when the temperature is said to have risen sometimes to 102° or 104° Fahr. Dr. Johnson gives the following diagramatic representation of the state of the heart, lungs, and large vessels when death has occurred during the stage of collapse in cholera, from an original drawing by Mr. John Wood. The lungs weighed very much less than usual, often not half their usual weight; and on section they appear dry. The blood they contain is all in the branches of the pulmonary arteries: it is black-looking blood—thicker than usual, but still fluid, so that on puncturing a vein, such as the jugular, it escapes in such quantities that the right side of the heart is emptied in a few minutes (SUTTON). The anterior portions of the lungs were of a grey colour—very much paler than normal: the posterior portions and the bases of the lungs were much darker in colour, soft in consistence, and easily broken down. A section of the lung substance rapidly became of a bright scarlet colour on exposure to the air.

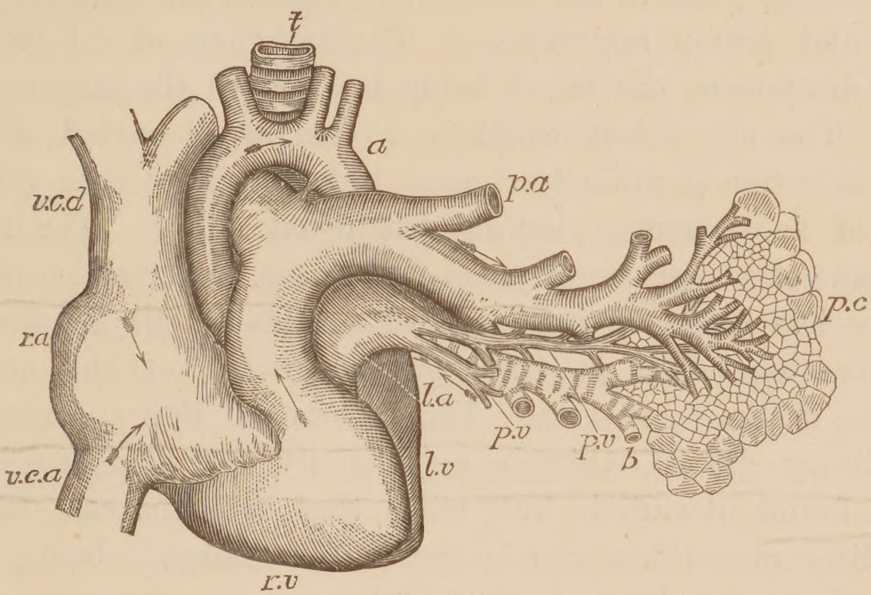

Fig. 1.*

Such are the appearances which the body has presented when the patient has died in the first, the asphyxiated, pulseless, or collapse stage. The enlargement of the solitary follicles of the intestines is believed to be peculiar to those cases in which diarrhœa, or other disorder of the alimentary canal, had for some time preceded the fatal attack. This enlargement bears no relation to the intensity of the disease, being often most conspicuous in the least severe cases; and it is an appearance now considered of secondary importance, and consequent on the purging. In the experience of Dr. W. T. Gairdner it has been found in about two-thirds of the cases.

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* EXPLANATION OF THE FIGURE (after Dr. Johnson).—The venæ cavæ, the right cavities of the heart, and the pulmonary artery with its branches, are seen to be distended; while the pulmonary capillaries, the pulmonary veins, the left cavities of the heart, and the aorta with its branches, are comparatively empty:—(*v. c. d.*) vena cava descendens; (*v. c. a.*) vena cava ascendens; (*r. a.*) right auricle; (*r. v.*) right ventricle; (*p. a.*) pulmonary artery; (*p. c.*) pulmonary capillaries; (*p. v. p. v.*) pulmonary veins; (*l. a.*) left auricle; (*l. v.*) left ventricle; (*a.*) aorta; (*t.*) trachea; (*b.*) bronchus.

When the patient has survived until re-action has taken place, and the second or febrile stage has been formed, the body no longer presents that shrunk, worn, and livid appearance it did on death taking place in the first stage; but, on the contrary, rather a full and plump appearance. The injection of all the large organs disappears, the blood being recalled to the surface of the body. The alimentary canal is no longer distended with the turbid secretion peculiar to cholera, but contains a thin yellowish *purée* of fæcal matter, having the usual odour. The mucous membrane of the alimentary canal has now, however, been found more or less diffusely inflamed, sometimes in all its divisions, but more especially in the pyloric portion of the stomach, and also in the duodenum. The glands of Peyer, as well as the solitary glands, though occasionally found enlarged, were seldom found ulcerated; but when that was the case the corresponding mesenteric glands were also enlarged, being sometimes pale or purple, and when cut into, gave issue to a dark liquid blood.

The *post-mortem* appearances, and the order of the symptoms tend to show that the blood is obstructed in its passage through the lungs; and that the loss of animal heat, embarrassment of the respiration, and gradual arrest of circulation, are produced by some aberration of the proper respiratory changes, or impediment to them. But as the mechanical part of respiration remains perfect, and as there is no impairment in the voluntary command of the respiratory muscles, and as the heart evidently beats in many cases till stopped by the want of blood on the left side, and by its accumulation on the right side, "we are compelled to look," says Dr. Parkes, "for the cause of such arrest of the circulation in the only remaining element of respiration—namely, in the blood itself" (*Researches into the Pathology and Treatment of Asiatic or Algide Cholera*, p. 107). Dr. Parkes and Dr. Garrod, of London, and Schmidt, of Dorpat, have made the most important researches on the chemistry of the blood in cholera. The latter observer has attempted to trace out the exact chemical steps which attend the period of transudation *from* the blood into the intestinal canal. The most prominent phenomena of cholera, during this period of transudation, consists in "separation of the water and of the salts of the intercellular fluid (of the blood) through the mucous membrane of the intestinal canal, and the retention in the blood of an important excess of albumen, and of blood-cells, with apparently less, but in reality with great diminution of the salts and fibrine." The period during which this transudation takes place is generally one of definite duration (about thirty-six hours), and in it the serum and fibrine (intercellular fluid of the blood) are first affected. Water, salts, and a small portion of albumen, pass off, and form the well-known liquid stools. The order in which the constituents of the serum are affected is thus stated by Schmidt:—The water transudes before the solids of the serum; the inorganic before the organic solids; the chlorides before the phosphates; the salts of soda before the salts of potash; and the order is very much the same as takes place during the action of purgative medicines, such as *elaterium*. Very soon after this transudation commences, an important change occurs in the blood: the normal diffusion currents between its fluid part and the fluid in the blood-cells alter; and the constituents of the blood-cells transude into the serum, in the same order as the constituents of the serum transude into the alimentary canal; that is to say, the water diffuses more readily than the solids; the inorganic solids more readily than the organic; the chlorides (and of these the soda salts) more readily than the phosphates. The result of all these changes in the fluid of the blood, and in the blood-cells, is, that at the height of the transudation-period the constitution of the blood is profoundly altered. The inorganic constituents, if compared to the water, are during the first four hours increased, because at this time the water is passing off with great rapidity; afterwards, as the salts pass off, the disproportion is lessened, and after eighteen hours or so the proportion of salts is greatly diminished, and, if compared with the organic constituents, the diminution is enormous. With respect to the individual salts there is in the blood a relative preponderance of phosphates over chlorides, and of potash salts over soda salts. By the end of eighteen hours or so, the blood-corpuscles are left in a most abnormal condition. The great loss of water and of salts, especially of the chloride of potassium (a most important constituent of the blood-cells), at once leads to the conclusion that their functions must have been greatly impaired. Schmidt accordingly found that the amount of oxygen contained in them was lessened by one-half.

According to the observations and analyses made by Dr. William Robertson, of Edinburgh, the fibrin of the blood is usually in large amount, and coagulable with great firmness. On the other hand, defective or imperfect coagulation of the blood in cholera was observed by Dr. Parkes as occurring in little less than a quarter of the whole number of cases observed by him. The presence of fibrin in the blood was not indicated by any coagulation either in or out of the body; and, whether coagulated or not, the blood has usually a dark colour; but it generally acquired an arterial tint when brought into contact with the air in thin layers. Dr. Robertson's observations were made on the cases occurring in the Edinburgh epidemic of 1848 and 1849; while Dr. Parkes's observations were made on two severe epidemics of cholera in India in 1843 and 1845. He also made the interesting observation, that a few drops of the thick substance taken from the intestines had sometimes the effect of restoring the vivid arterial colour of the blood. During the transudation into the intestinal canal, it appears that the diffusion currents *from* the blood into various structures are diminished; while, on account of the density of the blood, the inverse currents *from these structures to* the blood are augmented in rapidity. In this way fluids are drawn from the muscles, the viscera, and, in fact, most of the tissues; and it is probable that these fluids are charged with substances (such as sugar, &c.) which, under ordinary conditions, are taken very much more slowly into the blood, and are soon decomposed when they get there. The extent to which the blood is contaminated and injured by this admixture, and also by the retention of urinary constituents, is not yet accurately known. "When we remember," says Dr. Parkes, "the great share taken by the blood-globules in the respiratory and heat-furnishing processes, it is scarcely possible to avoid concluding that their loss of salts is connected with the characteristic cyanosis and lowered temperature in cholera. In *most* cases there is vomiting and purging before there is loss of heat, though this very soon follows in a slight degree, and then gradually augments. In other words, the diarrhœa coincides with the first or early chemical changes in the blood—the transudation of some of the constituents of the serum. The lowered temperature follows afterwards, at the time when we know that diffusion from the blood-cells into the serum must be taking place, and augments gradually as the diffusion increases." In all the cases examined by Dr. Marcus at Moscow, in 1832, the clot and serum evinced acid qualities on the application of litmus, except in four cases, where the discharges were watery and the re-action alkaline. The phenomena of the disease may thus be traced from the transudation of serum constituents as the starting point. All the other chemical changes in the blood, and the most marked symptoms (such as the abnormal respiratory process), follow as a matter of course.

But the question may be also put in another form, as it has been already so well put by the able reviewer of Dr. Johnson's book in the *Saturday Review*,—" Why has the circulating " blood stopped here (in the pulmonary arteries), and by what " means has it been brought to a stand? Were the arrest " of motion due to gradual thickening in consequence of the " continued abstraction of its liquid portion, it would be found " stagnating in the capillaries, as well as in the arteries. It must " be borne in mind that one characteristic symptom of cholera— " that symptom which, irrespectively of the fatality of the disease, " renders it truly a disease to be dreaded—consists in very painful " cramps of the larger muscles of the body. These contractions, " it may be assumed, are produced by the choleraic poison, just " as we know they are producible by the poison of strychnine. " Dr. Johnson supposes that a similar spasm or cramped state " of the muscular fibres which embrace, and by their natural " contractions regulate the size of, the minute pulmonary arteries, " is caused by the same choleraic poison, and bars these slender " channels against the advancing blood. The thickening of the " blood is a consequence, and not a cause, of the collapse. Pre- " cisely in the same way does a similar condition of the muscular " fibres of the smaller air-tubes of the lungs constitute a fit of " spasmodic asthma. . . . . Thus the emptiness of the systemic " arteries accounts for the extinction of the pulse at the wrist, " for the cadaverous sinking in of the eyeballs and falling of the " features, for the blueness and coldness of the skin, and for the " absence of syncope. The circulation stops, not from debility " of the heart, as in exhaustion, but in consequence of a direct " mechanical impediment to the onward course of the blood. " We can understand the impotence of brandy against this con-

"dition; and how, on the other hand, bleeding may help, both "by relaxing the spasm and by unloading the distended right "heart, to restore the circulation. Into this explanation Dr. "Johnson presses, plausibly enough, the singular effect of the "injection of fluids into the veins of these patients. It appears "that, to be influential at all, the fluids must be hot; and "he concludes that they act chiefly by relaxing, through their "warmth, the spasm of the smaller arteries. The blood then "flows on again, and the symptoms of collapse are for a time "removed. Again, the husky whispering voice is owing, not to "muscular weakness, but to the small volume of tidal air in "the respiratory currents. As but little venous blood reaches "the lung tissue proper, there is but little demand for air to "meet and decarbonize it. The respiration accordingly becomes "shallow, and the vocal pipe, feebly blown through, refuses to "speak. Under the temporary impulse of the warm injections, "the voice regains its usual tone and note. Once more, there "are chemical and less obvious changes already noticed which "receive their explanation from this theory."

Such is the nature of cholera, according to the observation of Drs. Parkes, William Robertson, Schmidt, Johnson, and Sir Thomas Watson; and thus "an early theory of the nature of this disease has received the support of the best physicians and chemists of the day—namely, that the blood, if not the primary seat of the disease, becomes eventually contaminated by the action of a specific poison." *

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* "The belief," writes Mr. Simon in his *Report on Public Health* for 1866, "that the proximate cause of cholera is a 'poison' first acting in the blood is common to Dr. Parkes and Dr. Johnson, as well as to many other writers; and Dr. Johnson builds on that belief his advocacy of a particular principle of treating cholera—the principle, namely, of 'assisting nature,' by emetics and purgatives, in what he deems to be her 'salutary and curative efforts' of vomiting and purging: but Dr. Parkes's doctrine of the state of the circulatory system in collapse, and Dr. Johnson's doctrine of the dependence of that state on spasmodic closure of the minute pulmonary arteries, are doctrines which do not necessarily involve an acceptance of the 'eliminative treatment' of cholera, nor pre-suppose any belief that cholera begins as a blood-disease. It is important that the different questions should not be jumbled together as one; particularly important now, because the notion of a primary blood-poison in cholera seems tending more and more to be superseded.

"1. First, as regards the state of the circulation in collapse. Personally knowing Dr. Parkes's great accuracy of statement, I attach (says Mr. Simon) the utmost importance to the descriptions contained in his work. And their details do

Origin and Modes of Propagation of Cholera.—One of the most interesting facts brought out by Dr. Farr and Mr. Radcliffe is,

certainly in great part justify the generalization which he makes of them.* But whether the morbid phenomena which he describes are rightly accounted for by the doctrine of arterial obstruction in the lungs (either such as he supposes, or such as Dr. Johnson supposes) is matter of much more doubt: for feebleness of heart-contraction appears to be an invariable fact in choleraic asphyxia; and so far as this affects (or at least predominantly affects) the right side of the heart, so far it tends to produce much such a disturbance of circulation as would result from the supposed arterial obstruction. Present opinion seems, I think, generally to be that, in the main, it is the dynamical affection of the heart (not the supposed obstruction of pulmonary arteries) which gives the true explanation of Dr. Parkes's facts; but this would not of necessity imply, either for the pulmonary or for the aortic circulation, that all the arterial resistances are normal. Whatever etiological view be taken of the connection of the symptoms of collapse, it cannot be deemed unlikely that a much diminished volume and impaired fluency of the blood, when they have arisen, should excite certain phenomena of their own in the sphere of arterial contractility, as well as have their own physical consequences; nor, again, that certain changes of arterial tone should go with certain changes of cardiac action. Be this as it may, some of the phenomena presented in the aortic system in collapse are such as arterial contractility would seem very plausibly to explain. Such are some of the inequalities of temperature and circulation in the diseased body, not only as between internal and external parts, but as between different parts (external or internal) in the aortic circulation. Specially, for instance, I cannot conceive from what other basis to explain the tendency to equalization of temperature between external and internal parts which is apt to show itself in the fatal ending of collapse, and even to continue after death, as though a final relaxation of arterial rigidity permitted the blood at last to find way through its normal channels. And if the cold and cyanosed state of external parts in cholera be not to some extent under control of arterial contractility, I cannot conceive through what mechanism to explain that exceptional state of mammary circulation which permits the continued secretion of milk by nursing women who are in collapse.

"2. The belief that a primary 'blood-poison' is the proximate cause of cholera, the direct source equally of its intestinal and of its asphyxial manifestations, is, that since the first great outbreak of epidemic cholera in this country in 1832-33, an enormous development of diarrhœa,

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* "Yet it deserves notice," says Mr. Simon, "that even among Dr. Parkes's own cases of death in collapse the *post-mortem* evidence of interrupted pulmonary circulation was not universal; and I may add, though without attaching equal importance to the fact, that a citation of miscellaneous authorities on the state of the heart and lungs in death by collapse (such a citation as was given in 1833 by Prof. Phœbus in chapters v. and vi. of his classical *Leichenbefund bei der Orientalischen Cholera*) would show still less uniformity of evidence in that respect. Also, in my opinion, the assertion made by Prof. Griesinger (in § 483 of the admirable essay on cholera which forms part of his *Infections-Krankheiten* in the *Handbuch der Pathologie und Therapie*) deserves much weight, viz., 'that the distention of the right cavities of the heart appears not to be present during life, as percussion gives (invariably?) a small area of cardiac dulness.' Supposing the general accuracy of Dr. Parkes's descriptions to be conceded, judgment must, I think, be reserved on the meaning of the alleged exceptions. For, whatever question there may be as to the inter-dependence of the symptoms of cholera, it is certain that the disease, in proportion to its flux, tends to reduce more or less rapidly both the volume and the fluency of the blood; and till we know exactly what would be the ultimate anatomical expression of those changed physical states of the blood, taken by themselves, it is impossible to affix a right value to the cases of cholera where *post-mortem* appearances, or facts observed during life, have not answered to Dr. Parkes's general description of the anatomy of death in collapse."

so far as I know, mere hypothesis. It has been much accepted as the only possible explanation of certain supposed, but very questionable facts in the natural history of the disease; specially in explanation of the supposed fact, that the utmost collapse of cholera may concur with little or no affection of the intestinal canal. It is of supreme pathological importance to be right in the matter of these premises. Is it, or is it not, true that choleraic asphyxia can arise otherwise than in consequence of the bowel disease? This question has been much perplexed, partly through the vast number of vague assertions which are current on the subject, and partly through an assumption which has often been prematurely, and perhaps wrongly, made, that the significance of the bowel disease in cholera is to be measured by the quantity of the fluid secretion from the bowel. Properly to discuss the main question, that assumption must be disallowed, and the points be separately considered.

"*a.* That the large, often enormous, fluid discharges which generally characterize cholera represent corresponding *de-aquation* and *de-salination* of blood and textures in the patient's body, and that such changes must at least for a time interfere to some considerable extent with all or most of the chemical processes of the body, cannot, I suppose, be disputed. And on the hypothesis that cholera begins in the bowels, it might seem probable that all, or nearly all, the facts of collapse and secondary fever would admit of being referred, directly or indirectly, to that generally enormous flux. Especially it would seem plausible to refer to the altered blood either a power of mechanical obstruction, or a power of provoking resistant muscular constriction, in the vessels through which it has to pass. At present, however, very strong arguments against any such doctrine of collapse are adduced. Dr. Goldbaum's conclusion, in his recent report (published in *Virch. Arch.*, Feb., 1867) of the experience of the Berlin Cholera Hospital No. III., in the epidemic of 1866, supported by many illustrative cases, is strongly against the doctrine that inspissation of the blood is the cause of the asphyctic state. He (like many previous observers—notably the chief Anglo-Indian authorities, and in Europe, Magendi, Romberg, Parkes, and others) insists that the relation of flux to asphyxia is rather an inverse than a direct proportion, and that the cases of worst augury are cases which have fallen into collapse after but little or no vomiting and purging. He, moreover, expressly guards against undue importance being attached ~~in such~~ cases to the quantities of fluid (half or two-thirds of a gallon at the utmost) which may be retained within the patient's intestinal canal; pointing out that the contrast is with cases where perhaps as much as seven gallons are discharged by vomiting and purging, and that consequently no allowance made for intestinal contents can affect the truth of his proposition. In this context, too, it seems convenient to refer to the comparison which many experienced observers of both sorts of disease have drawn between the phenomena of cholera collapse on the one hand and those of the cold stage of malarious disease on the other. Dr. Goodeve, for instance, in his article on cholera in *Reynold's System of Medicine*, arguing that 'symptoms similar to collapse may be produced by poisons without any purging,' observes that he has 'seen people under the influence of malarious poison in Calcutta lie for hours as cold and pulseless, and as embarrassed in the breathing, as in cholera.' No doubt both sorts of collapse have very much in common as regards their spheres of manifestation, and much also as regards the phenomena them-summer cholera, and diseases of a choleraic character, have been unusually fatal in the metropolis and England generally; that the

selves; but of course the likeness between them does not exclude the possibility that they may be induced by very different causes.

"*b.* As regards the other point, materials for judgment are less definite; but certainly, in the present state of information on the subject, the proposition is by no means established that cholera collapse ever occurs without bowel disease enough probably to account for it. Abstraction of fluid, I need hardly observe, is not the only way by which abdominal lesions can affect the circulation of the blood. There are channels for nervous as well as for humoral sympathy; and the heart's action can be lowered to the utmost (whether with consensual changes of arterial tone, I know not) by abdominal lesions in which little or no fluid is expended. Physiologists will remember those admirable researches of Goltz * and Bernstein †, which elucidate the exact course and mechanism of such sympathies; and every practitioner of medicine or surgery can recall instances where he has seen mortal collapse (substantially, so far as I know, not different from the collapse of cholera) produced by the very onset of traumatic and other abdominal inflammations, sometimes of no great apparent magnitude. In comparison with some of such instances, the least amount of bowel disease which (so far as I know) has ever yet been found in the bodies of persons dead with the cholera collapse, must, I believe, be deemed very considerable. Doubtless there are cases on record where men stricken with cholera collapse are said to have suddenly fallen, even numbers of them together, in the streets or elsewhere in their ordinary pursuits, 'tumbling over each other lifeless,' or as if 'knocked down dead by lightning,' or 'as if they had drunk the concentrated poison of the upas tree.' It may well be that some of these pictures are unintentionally overdrawn; representing less the real objective occurrences than they represent that utter dismay, that sense of mysterious death too swift for remedy, which severe epidemics of cholera are singularly apt to produce. But, taking them at what they are worth, what reason is there to believe that the sufferers who were so stricken down had not bowel seizure as the ground of their collapse? No doubt the opinion has been current that cholera, acting in some mysterious way on the total organism, may 'kill and leave no sign;' but in proportion as exact morbid anatomy has been cultivated, that opinion has, I think, more and more seemed to rest on a mythical basis; and the doctrine of primary collapse ought at least, without hesitation, to be rejected for cases where *post-mortem* examination of the bowels has not been made. In illustration of these remarks, I would refer very particularly to the important case given by Dr. Sutton, in his report *On the Clinical Characters of Cholera*, 1866. It was a typical case of *cholera sicca.* It was a case of cholera death so swift that probably none of the reported 'upas poisonings' were swifter. But fortunately the body was anatomized. The whole length of the small intestine was found containing choleraic effusion; and to assume, in the face of that fact, that the cholera collapse was primary, would, in the present state of knowledge, be, to say the least of it, a simple *petitio principii.*

"In the present state of knowledge, then, I do not find it proven, nor do I see any theoretical convenience in taking for granted, that cholera begins as an active blood-change capable of producing primary collapse. The facts, so far as I know them, can all be reconciled with the belief that cholera begins as bowel disease, mortality from them suddenly rose in 1827, and progressively increased till 1831; and that diarrhœa has continued to go on gradually increasing in fatality since 1838. It proved fatal, *per se*, evidently as a variety of cholera, chiefly to young children and to old people, who did not so commonly exhibit the spasms of cholera (which are not essential to the disease), but

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* *Virch. Arch.*, vol. xxvi.

† *Reichert and Du Bois Reymond's Archiv.*, 1864.

producible by direct contagion, without even a passive intervention of the blood, and that all asphyctic phenomena of the disease are supervenient sympathetic phenomena. That, so far as they are facts of cardiac paralysis and arterial contraction, they may be attributed to nervous sympathy between bowels and circulatory system, without reference to the greater or less humoral effect of the coincident flux from the bowels, is at present a tenable view. At the same time, I hesitate to accept as proven that cholera collapse is independent of humoral sympathy. That it may often be apparently so is, no doubt, well shown by the statements I have quoted from Dr. Goldbaum and others. But it must be remembered that in those comparative statements two most important variables are not taken into account. First, there is the varied rapidity of the local morbid process—a very considerable range of difference; and it is imaginable that the power of the intestinal flux to produce collapse may vary with the rapidity, rather than with the mere degree, in which it tends to inspissate the blood. Secondly, there is the varying susceptibility of the individual patient; and that this has range enough to account for very considerable differences of manifestation in the functions concerned in collapse will be evident to any one who has attentively studied the very kindred subject of febrile rigors. Indeed, the power of both the variables in question may be illustrated from that analogy; for all observers know how essentially the rapidity of the thermal rise is the determining condition for the rigor; and all equally know how one patient suffers rigor to the very verge of death from influences which would not appreciably disturb another one.

"In questioning the fact of a primary blood poisoning in cholera, I, of course, do not intend to deny that the blood *during* cholera is poisoned. From our earliest knowledge of the disease it has been on record that, when pregnant women have cholera, the intra-uterine offspring almost invariably dies; and more recently, in proportion as the anatomy of the disease has got to be better studied, cases have accumulated, giving detailed evidence in support of an opinion which had from the first been entertained, that the infant in such cases dies of true choleraic infection. Waiving particular reference to earlier cases of this sort (for which see, for instance, Phœbus, 1833, op. cit. § 51,* and Buhl, 1856, in the famous Bavarian report) I may quote some statements made by Dr. Goldbaum in the report to which I have already referred. In the three last epidemics, he says he has carefully anatomized twenty-two such infants, and never failed to find appearances which, collectively, he deems characteristic of cholera. 'In the stomach and upper part of the small intestines always there was a fluid like rice-water, sometimes a thick mass, consisting of exfoliated bowel epithelium; the heart was always ecchymosed; at the back of the tongue there were swollen papillæ, as there are in greater degree in adult cholera corpses; and in the kidney the yellowish cortex contrasted strongly with the more blood-holding medullary substance.' It may, I think, be assumed died with nearly all the other symptoms of the malady. It proved fatal as a cause of death in other diseases. "It killed sick and dying men;" and now, at least, a belief prevails that cholera has become indigenous to this country; and assuming that it is produced by the action of a specific poison, how is it reproduced and propagated?

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* "Among the cases given in Phœbus's work is one where the infant was not actually born dead, but died an hour afterwards with all symptoms of the epidemic disease."

The chronological and geographical history of cholera has commonly been considered as affording *primâ facie* evidence that, as regards this country, it is originally an exotic disease, the product of another climate, which yet has met with conditions favourable for its development and propagation in this country. It is now quite clear (as Dr. Macpherson has shown) that exactly the same disease as Indian cholera was known in India when the Portuguese went there first about the year 1500. The disease in India has had periods of increase and of decrease; but it was never diffused in that country so widely as it has been since 1817; nor had it ever wandered so extensively from India before. Whatever cholera we may have had in Europe in former times, few doubt that since 1817 it has always been carried out of India, or Persia, or Arabia, to other places.

Several explanations or theories have been proposed, to

for certain that the death of the fœtus is death by cholera,* and that the fœtus is infected through its blood. And since its blood is a mere derivative of the mother's blood, the fact seems to be beyond dispute that the mother's blood had cholera contagium in it. In relation to our main argument, however, the question is virtually unchanged. Is there any reason to suppose that the cholera contagium in the mother's blood was not a secondary product of disease—was not let into her circulation from the ferment-seething interior of her bowels? In this point of view the case may be usefully illustrated by another and closely kindred fact. Dr. Thudichum (see p. 477, *Ninth Report on Public Health*, 1867) has made the important observation, that sometimes in cholera the blood, like the rice-water of the intestinal canal, contains butyric acid. He does not believe that this poisonous product of fermentation is primarily formed in the blood; he believes that it is only to be found there when, after collapse, absorption from the bowels has recommenced, and when evidently the presence of that and other like matters in the blood can be interpreted as a fact of secondary infection from the bowel."

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* "I have been most anxious," says Mr. Simon, "if possible, to bring this assumption to the test of actual proof, by causing infection experiments to be made with the intestinal contents of such cases; and I have communicated with various persons on the subject. Unfortunately, the only fœtus which came within our reach was that referred to in Dr. Thudichum's report. Its intestinal contents were given to Dr. Sanderson for the purpose, and were used by him in the intended manner, but with only a negative result. The time of year had unfortunately been reached when, as he has stated, all infection experiments failed; and therefore no conclusion whatever can be drawn from this one test of the fœtal rice-water. The general evidence, however, seems fairly conclusive as to their nature."

explain the occurrence of cholera in this country. According to Sir Ranald Martin, they may be referred to the following six heads:—

1. That the disease spreads through *atmospheric influence or epidemic constitution*, by a succession of local outbreaks, and that the particular localities affected are determined by certain "*localizing conditions*," which are—*first*, all those well-known circumstances which render places insalubrious; and, *second*, a susceptibility to the disease in the inhabitants of such places, produced by the habitual respiration of an impure atmosphere.

2. That the cause of cholera is a morbific matter which undergoes increase only within the human body, and is propagated by means of emanations (or discharges) from the bodies of the sick; in other words, simply by contagion in the most limited sense of the term.

3. It is believed that the poison of cholera is swallowed, and acts directly on the mucous membrane of the intestines, and is at the same time reproduced in the alimentary canal, and passes out, much increased, with the discharges; and that these discharges afterwards, in various ways, but chiefly by becoming mixed with the drinking waters in rivers and wells, reach the alimentary canals of other persons, and produce the like disease in them.

4. Assuming that the cause of cholera is a morbific matter or poison, it is probably reproduced in the air, as well as within the bodies of those whom it affects, and that its effusion may be due to the agency of the atmosphere.

5. It is believed that the cholera poison is increased by a species of fermentation, or other mode of reproduction, in impure, damp, and stagnant air; and it is maintained that it nevertheless is distributed and diffused by means of human intercourse, being carried in ships and other vehicles, and even in the clothes, especially in the foul clothes of vagrants, and the accumulated baggage of armies.

6. It is assumed that the material causes of the disease may be increased and propagated in and by impure air, as well as in and by the human body.

"Germany and England," as Mr. Simon justly observes, "may claim between them the credit of having built up all the definite knowledge we yet possess regarding the pathology of cholera." Griesinger, and Hirch of Berlin, Wunderlich of Leipzig, Pettenkofer of Munich, Thomé of Cologne, and Klob of Vienna; combined with Orton, Tytler, Parkes, Greenhow, Snow, Sutton, Martin, Macpherson, Buchanan of London, and Dr. Andrew Buchanan of Glasgow, Budd, Baly, Gull, Marshall, Radcliffe, Lauder Lindsay, Thudichum, Sanderson, Beale, Farr, and Simon, are those who have most of all contributed extensive and definite observation under varied circumstances and numerous epidemics in this country and in India.

The microscopy of the body in cholera, and especially of the stomach and intestines, has led in Germany to the re-discovery (by Drs. Thomé and Klob) of microscopical bodies like *fungi*, innumerable and vehemently multiplying, whereof swarms are shed with prolific and infective power in each characteristic evacuation of the sick. At the International Medical Conference on cholera, which met at Easter of 1867, at Weimar, and which Mr. Simon attended, Professors Hallier of Jena and De Bary of Halle (two of the leading mycologists of Germany) were associated with Dr. Thomé and Klob to make, in common with them, a statement and appreciation of the facts which had been observed, and which are in substance that—"Both observers find in cholera evacuations and in the intestinal mucus of the dead body definite organic structures, consisting of excessively fine granules, clustered more or less densely in the interspaces of a jelly which surrounds them. The granules divide and sub-divide themselves, to form beaded threads, which interlace in immense numbers into felted masses in the mucus. The further development of these organisms have been determined by Thomé and Hallier. By sowing or cultivating them, these observers have got, after some time, larger round cell-like bodies, which rapidly multiplied, and also abundant filamentous fungi (*cylindrotœnium*) on which grew cylindrical spores, capable of developing again to filaments" (*Ninth Report* of Mr. Simon, p. 31).

It is the peculiar property of some of the fungi to develop a viscid secretion by which they are enveloped, and the gelatinous mass with which the spores described by Klob is surrounded seems due to this development by the spores of *fungi*, and is not to be confounded with the intestinal mucus. This gelatinous mass forms with the spores the *Zooglœa termo* of Cohn; and in some instances the intestinal contents were entirely composed of this *bacterium* jelly.

In 1849 the question of *fungi* in cholera stools was repeatedly discussed on the repeated observation of several independent observers; but the objects then described do not seem capable of precise identification, or as being exactly the same as those now described. On the authority of Mr. Simon, it would appear that Boehm in 1838 describes "the whole extent of the intestine as teeming with a vegetation of *micro-fungi;* that innumerable round and oval, or more elongated corpuscles are to be found in all the vomit and dejections, as well as in the canal, sometimes single, sometimes two, three, four, or more, joined end to end, as links of a chain, and these chainlets sometimes branching; that such forms are held together in mucous floccules, and come best to light when *liquor potassæ* is used; that within the small intestine they are often so numerous that not the smallest specimen will fail to show numbers of roundish *fungic* forms amid the debris of epithelium" (*Uber das vorkommen der Gährungokeime* (*Pilze*) *im Nahrunga-Kenal der Cholera-Kranken,* quoted by Mr. Simon, *Ninth Report,* p. 518).

In the microscopic examinations of the "rice-water stools" of cholera in 1848 made by Dr. Parkes (whose observations were at the time confirmed by Drs. Sharpey and Jenner, and by Bowman, Hillman, Ellis, and Quekett), "peculiar corpuscles" were observed, and were variously named as such, or as "dark-yellow granules," or as "organic corpuscles (about the size of the pale corpuscles of the blood), finely granular on the surface, and containing from six to twelve dark-yellow or black granules." Without being able to state what these "peculiar corpuscles" are, Dr. Parkes goes on to show that they are not mucous, but that their existence and development is confined to the deep algide period—that they are not seen in the premonitory diarrhœa, nor after the algide stage, and disappear when the pulse and the warmth of the surface are returning. They co-exist in their greatest perfection with the purest type of the cholera fluid, (*London Journal of Medicine,* 1849, p. 144, *et seq.*) Thus Dr. Parkes, and those observers who aided him, recognized certain "peculiar corpuscles or granules" in the rice-water stools of cholera; but neither of them suspected the peculiar corpuscles or granules to be of vegetable or fungoid origin. They appeared then to Dr. Parkes to be "but modifications of the same substance, namely, fibrine." He, however, recognized "vibriones in great numbers, and two or three oval transparent bodies placed end to end. When the stool was kept, these fungi increased in numbers" (Ob. 6). In the descriptions and plates of Klob, Thomé, and Hallier, the corpuscles and granular bodies which they figure are now recognized by Dr. Parkes as similar to those which so attracted his attention in 1849. He again noticed these bodies in 1865 and 1866, when they vividly recalled the previous observations to his mind. Dr. Parkes concludes from these and his own observations that this fungus development really exists, and invariably in cholera dejections. He found them in every stool which he examined in 1849 and in 1854; and he again saw them in 1865 and 1866. He is familiar with all the forms described by Klob and Thomé; and believes them universal in cholera stools; and they form the major part of the white flocculi of the true "rice-water stools" (*Report on Progress of Hygiene in Army Med. Dep. Reports for* 1865). In 1854, Dr. Lauder Lindsay also recognized large bodies which he named "gonidic," from their resemblance to the gonidia of the lichens. They appear quite globular, usually larger than pus corpuscles; have a distinct wall, colourless and transparent; frequently a distinct central nucleus, also colourless, round which are aggregated a number of rounded granules of a bright greenish-yellow or orange colour, resembling the chlorophylle grains in the cells of plants. These bodies have occurred in greater or less abundance in the evacuations of *all* the cholera patients under Dr. Lindsay's charge; and they pass through the digestive apparatus both of man and the dog apparently without change (*Edin. Med. and Surg. Jour.*, 1854).

To say that these fungi are the cause of cholera would as yet be premature; nevertheless their existence is capable of accounting for many of the phenomena of cholera, and especially its spread. The poisonous properties of fungi are well known, so that, apart altogether from the physical influence of such spores, by their development in the intestines, the products of their growth may be eminently poisonous and deadly. In this direction the cultivation experiments may yet be carried.

Professor E. Hallier, of Jena, whose reputation as a fungologist is not surpassed, has made numerous experiments by the cultivation of these spores; and from an able summary of his paper by Dr. Buchanan (*Ninth Report to Privy Council*, p. 512), it appears that his observations were made on the stools of a person ill with cholera at Berlin in 1866, and on the stools and vomita of a cholera patient at Eberfeld in 1867. The characteristic vegetable elements consisted of a fine fungiform matter which floated, and of more highly developed spore-cysts which sank to the bottom (figs. 1 to 4 of engraved Plate). These spore-cysts were yellow or brownish bodies, consisting of a pale membrane enclosing highly refracting coloured spores. The cyst wall undergoes a series of changes, ending in its rupture or solution, when the spores become free. The spores then, by progressive (*tomiparous*) partition (a process which may begin before they leave the cyst), resolve into very small cells, grouped into balls and heaps, which Hallier calls "colonies of micrococcus." The small cells constitute the fungiform matter seen in the evacuations, and they attach themselves to any bodies there may be in the stool—to remnants of animal or vegetable food, to epithelium cells, or to oil-globules, when these and all nitrogenous matters to which these fungi cells fix themselves become of a dirty aspect and lose their structure.

Besides these two elements (the spores and minute cells), torula-like bodies (fig. 3, *c.*) were found in smaller number, and were shown by cultivation to develop from the micrococcus cells. The formation of these cells (which occur singly or in rows) marks a step towards a higher development of the micrococcus—towards the production of *oïdium** forms of fungi.

In the stool and vomit from Eberfeld, the cysts and colonies of fungi were found in smaller proportion, and the free micrococcus cells more abundantly, and epithelium was seen in which the process of invasion by the micrococcus could be watched. The little cells fastened themselves upon the epithelium, and increased in size as the epithelial elements wasted. The parasitic cells of fungi always grow at the expense of any nitrogenous organic substance which they attack; and this is well seen in the fungus foot disease (*Mycetoma*) of India. (See end of Vol. I.)

To learn the development and ultimate form, so as to identify the fungus, Hallier had recourse to the artificial cultivation of the spores, on several substances on which *fungi* are known to increase, multiply, and grow, such as in sugar, starch, paste, flesh, and the like (figs. 5 to 8 of engraved Plate), in the same way that our distinguished fungologist, the Rev. M. J. Berkeley, made out the nature of *Mycetoma*. In sugar, Hallier, conducting the growth at a temperature of 68° — 88° Fahr., succeeded in growing from the spore-elements a long pale filament containing granular plasma, and divided by septa; from this elongated processes branched off, and the whole formed a structure greatly resembling the *oïdium lactis*. This oïdium plant bore at the ends of its branches bulbs (*macroconidia*, fig. 7, *m*), either single or in shorter or longer series: if single, generally larger, and apt to develop *mucor* forms; but if in series, more apt to develop *penicillium* forms. On the ninth day of the experiment some of the branches bore a cyst containing spores, pale and weakly. Only once did a well-developed coloured spore-containing cyst make its appearance; and Hallier's experience led him to connect the absence of such cysts with the absence of nitrogenous matter from the soil in which the fungus was growing.

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* The oïdium fungi belong to the order *mucedines*—the "blue moulds"—having flocci very short, producing a monoliform string of spores by tomiparous division. In temperate climates they grow on damp paper, dead wood, decayed fruit (grapes, oranges), on *porrigo lupinosa*, on honeycomb, on nettles, ground ivy, and on plants infested with *ergot.* They belong to the family *Hyphomycetes*, or "thready fungi," the characteristics of which are filamentous, with fertile naked threads, for the most part free, and bearing the spores at their apices. (See Berkeley's *Outlines of British Fungology*, pages 337 and 350.)

A variation of the experiment, by providing the fungus with starch paste, produced scarcely different forms; but a more interesting result came of the addition of a small quantity of tartrate of ammonia to the paste. For the first few days of this experiment nothing but *micrococcus* cells, and chains of similar elements resembling *leptothrix*,* were seen; but about the fifth day there appeared a small brown speck in the paste at some little distance from the surface, at a spot where the re-action was alkaline. This brown spot gave to the microscope coloured forms, filaments bearing *macroconidia*, single and in series (fig. 7), and some of them also bearing bunches of spores, or well-developed cysts containing spores, and greatly resembling the cysts found in the original stools. Upon the occurrence of an acid re-action in the paste the growth of these bodies ceased. NB

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* These belong to the family *Coniomycetes*, or "dust-like fungi," of which the spores are the prominent feature, and not the threads (as in *Hyphomycetes*), the spores being either solitary or concatenated, produced on the tips of generally short threads, which are either naked or contained in a perithecium, or compacted into a gelatinous mass. *Rust* and *mildew* are examples of this family. *Leptothrix* consists of the mycelial filaments of mildew fungi, abounding in foul water in flocculent masses.

The spores of the fungi were further grown upon muscular tissue immersed in sugar solution. The micrococcus cells were seen enlarging and budding, and developed the usual *oïdium plant* with *conidia* at the ends of its branches. Shortly after numerous cysts appeared, which went through the same changes as the cysts in the original stool. The muscular fibres were invaded and decomposed by the micrococcus, just as the intestinal epithelium had been in the stool.*

A subsequent observation made with cholera fungi grown in Hallier's isolation apparatus, upon paste which had been boiled with tartrate of ammonia, gave highly developed cyst-formations with the contained spores in a state of actual germination, and pushing their processes through the cyst wall. This is the exact counterpart of a form known as *Urocystis occulta*, found in the tissues of cereals; and a very similar form, *Urocystis intestinalis*, is found in diphtheritic diseases of the intestine. The observation of cysts apart from filamentous growth, as they were in this

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* EXPLANATION OF THE ENGRAVED PLATE IN ILLUSTRATION OF PROFESSOR HALLIER'S EXPERIMENTS ON THE FUNGUS FOUND IN THE "RICE-WATER" STOOLS OF CHOLERA (p. 653 to 657 of text).

Figs. 1 to 4.—Vegetable Growths, of the Nature of Fungi, seen in the Cholera Rice-water Stools: Berlin, 1866.

1. Groups of swollen gelatinous spores in the act of forming *micrococcus* by repeated divisions of the nucleus. The spores are surrounded by *micrococcus* cells.

2. Gelatinous cysts swollen and breaking up. (*c.*) Small cyst with clear spores; (*l.*) gelatinous cyst; (*h.*) wall of cyst subsequent to discharge of the spores.

3. Yeast formations. (*m.*) A large colony of *micrococcus* corresponding with a spore; (*b.*) a large colony of *micrococcus* about to break up; (*k.*) a group of colonies originating from the spores of a cyst; (*c.*) *torula*-like cells grown from swollen and enlarged *micrococcus.*

4. (*n.*) Several cysts connected; (*o.*) a large globular cyst discharging its spores; (*a.*) semi-divided spore, showing the commencing formation of *micrococcus;* (*b.*) spore quartered; (*c.*) groups of spores from a small cyst.

Figs. 5 to 8.—Products of "Cultivation," No. 1: Berlin Rice-water Stool of 1866, with Sugar Solution.

5. *Micrococcus* and *torula* formations.

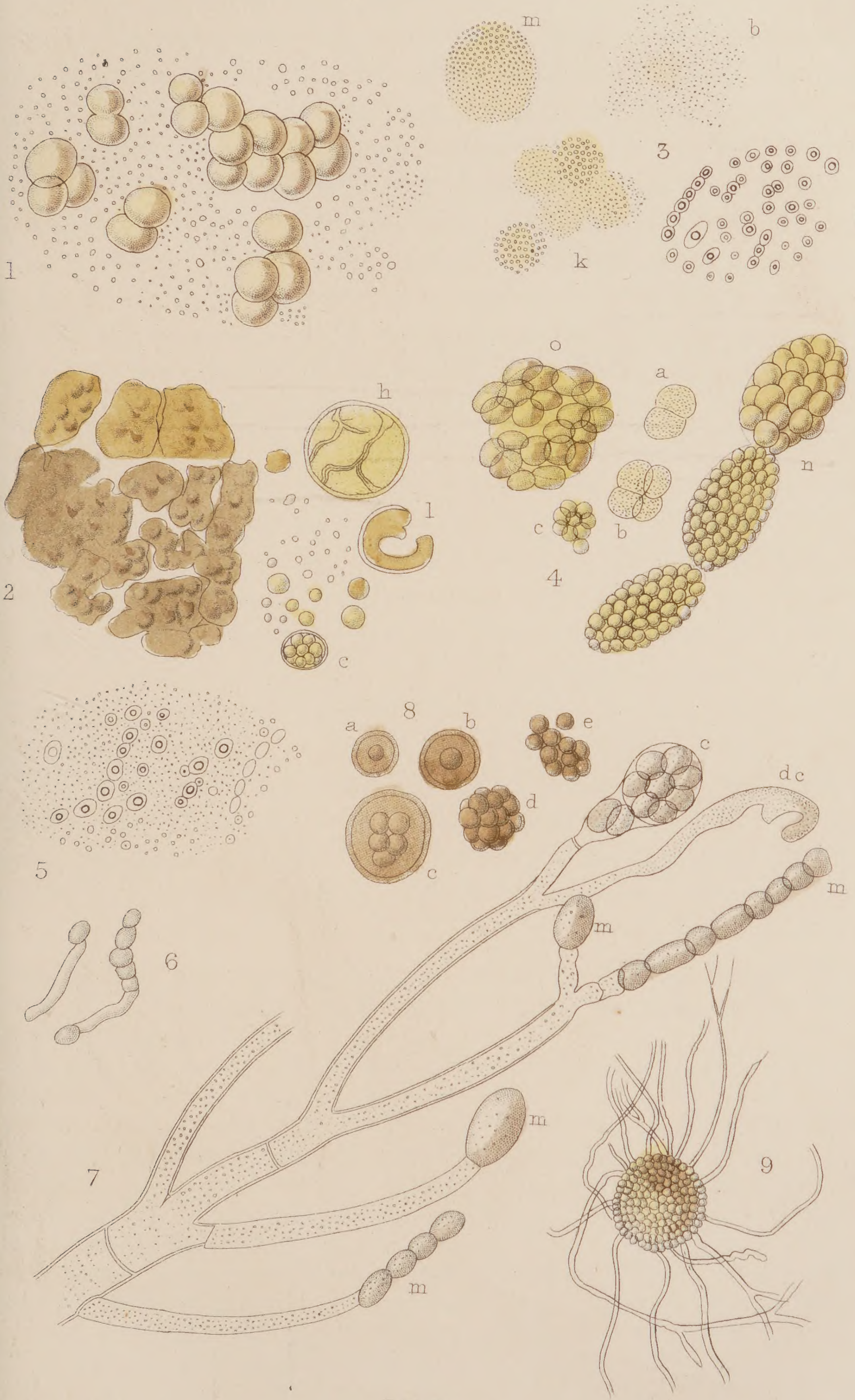
6. Germination of *torula* cells.

7. Filamentous termination of a healthy germ. (*m.*) *Macroconidiæ;* (*c.*) cysts; (*d. c.*) degenerated cysts.

8. Completely formed cyst with spores, one of which is just about to germinate, (*k.*)

Fig. 9.—(*a.*) Commencement of proliferation.

FUNGI, AND THEIR DEVELOPMENT BY CULTIVATION,
FROM THE "RICE-WATER-LIKE STOOLS" OF MALIGNANT CHOLERA
(AFTER Dr. ERNST HALLIER.)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H. Adlard sc.

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experiment, is particularly instructive, as it is under somewhat similar conditions that the development of the cysts, also apart from filamentous growth, takes place in the intestine of cholera patients. (Fig. 9, *a*, commencement of proliferation.)

Twenty-two such experiments were made with the cholera stools, and results consistent with those above described were obtained. Hallier's experience thus enabled him positively to prevent, and to know that he had prevented, the accidental entrance of any atmospheric fungus into his cultivation experiments. He proved the "peculiar corpuscles" to be spores of a fungus, and to belong to a species which comprises forms of *Penicillium*[*] *crustaceum*, *Mucor*[†] *ramosus*, *Tilletia*,[‡] and *Achlya*,[§] which are four different forms or developments of the *Macroconidia* in the same *oïdium-like* fungus. But in the actual rice-water stool it is none of these four developments, but a fifth, which systematists would place under the group of *Urocystis*.[||] Hallier has obtained in the course of his mycological studies oïdium plants exhibiting the other forms of growth, but he has never produced by artificial cultivation cysts of *Urocystis* on them, except from these cholera stools. Thus, in the course of innumerable observations on milk oïdium, where penicillium and mucor were met with, nothing resembling the cyst forms was ever seen. From this and other considerations, Hallier infers that this form is not indigenous to Germany, and that it has travelled with cholera from India. In the next place, he cannot think that the original *habitat* of the fungus should be the human intestine, which is under much the same conditions in India as in Europe; but he sees in the high temperature of the intestine a condition capable of maintaining this fungus in activity, once it is introduced (as it may be by direct intercourse with India). A similar high temperature, as provided by the mean climate of India, and by the extreme summer climate of Europe, also furnishes the condition requisite for the development of the fungus outside the body. Thus in summer, and in summer only, in European latitudes could the fungus find in earth and night-soil the necessary temperature for its increase. The conditions for the production of Urocystis appear by the experiments to be, not high temperature only, but also a copious supply of nitrogenous with some hydro-carbonous nutriment, and a high degree of moisture. But besides these conditions the re-action of the fluid was found to be important, and this again to be dependent on the nitrogenous elements of it.

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[*] *Penicillium.*—Hyphomycetous fungi, the commonest constituent of green and blue mould, a form which grows in all kinds of decaying substances, but especially in semi-fluid matters.

[†] *Mucor.*—Physomycetous fungi, bearing vesicles containing indefinite sporidia, the common mould of paste and of decaying fruit.

[‡] *Tilletia.*—Coniomycetous fungi, the "bunt" of various corn grains, especially the *Dhoora* corn of the tropics and the *maize* of temperate regions.

[§] *Achlya.*—An aquatic form of mucorinous fungi—parasitic on the bodies of dead flies in water, fish, frogs, and decaying plants. It appears as colourless filamentous tufts enveloped in a gelatinous cloud.

[||] *Urocystis*, of eastern habit, seem to belong to the forms of *Ustilago* of temperate regions, of the order *pucciniœi* and family *coniomycetes.* The spores of this order are simple, springing from delicate threads, or produced in the forms of closely packed cells, which ultimately break up into a powdery mass. The spores produce in germination secondary spores, and the plant is parasitic on living plants, and is deeply seated. Ustilago yields the "smuts" on corns and grasses of this country.

Hallier points out that the home of all penicillium-bearing fungi is Asia. The tilletia-bearing form occurs only on wheat, which is a plant imported from Asia. Hence he infers a further probability that the cholera fungus, which appears to be another development of the same species, is also originally Asiatic.

Further observations as to the precise effects of temperature confirmed the foregoing deductions. Fungus, while developing Penicillium only at ordinary temperatures, was grown upon appropriate nitrogenous soils at a temperature of 88° to 110° Fahr., and (when other circumstances were favourable) a development of cyst forms took place from the budding of the Penicillium, precisely like the forms met with in the stool. A piece of intestine exposed to the action of the cholera fungus at this temperature got its epithelial elements rapidly destroyed by micrococcus. Converse experiments with low temperatures showed that the characteristic cyst forms of cholera stools were not produced upon materials that were kept below 54° Fahr. The inference is therefore confidently drawn, that if the fungus be indeed the contagious material of cholera, cholera cannot maintain itself permanently in our latitudes. Other conditions under which the fungus did not grow were,—(1.) A temperature over

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144° Fahr.; (2.) Sulphate of iron in concentrated solution; (3.) Carbolic acid (not the most potent agent of its kind in these experiments); (4.) Permanganate of potash; (5.) Wine (from its acidity, probably) and strong alcohol. Quinine had some influence, opium none, in preventing the destruction of animal tissue by the micrococcus. Of all experiments made to determine the power of chemical agents upon the fungus, chief success was obtained by the free acidification of the fluid. This is confirmatory of Pettenkofer's views upon the disinfection by acids of substances infected by cholera poison. Whenever the fungus grew in acid solutions it showed no cysts and no micrococcus, only penicillium and cognate forms. For fungus destruction on the large scale Hallier would give preference to sulphate of iron. But he insists particularly on the destruction of each individual stool before mixing it with other night-soil, and of course urges the systematic removal of all such matters to the field.

Professor Hallier's inquiry is next concerned with the circumtances under which the cholera fungus, indigenous to Asia, and only travelling into northern latitudes in the bowels of cholera patients, grows in its native soil of India. He recalls the fact that other forms of the fungus under consideration are peculiar to cereal plants, and that the Urocystis, with its characteristic cysts, inhabits the delicate and highly nitrogenized tissues of grasses; and he asks whether the cholera cysts may not also in their native soil be parasites to some graminaceous plant, just as the form Tilletia, which can exist in a European climate, is a parasite upon the imported cereal, wheat, which acclimatizes itself in these latitudes.

Herein the circumstance assumes a peculiar importance, that at their first acquaintance with cholera English physicians in India named it "rice disease" (*Morbus oryzeus*, Tytler), and connected it with a diseased condition of the rice plant. Examination into the existence of a similar fungus attacking rice in India must of course be undertaken by inquirers in that country; and on the best authority (that of the Rev. M. J. Berkeley) we know nothing of the microscopic fungi of India; but Hallier makes a notable contribution to this aspect of the question by his experiments. He planted rice under conditions of heat and moisture as nearly as could be obtained like those of Asiatic rice fields, and he watered these plants with the stools and vomita whose investigation had occupied the earlier parts of his paper. He obtained in every one of these experiments positive results. Carefully taking out his little rice plants in an early stage of their growth, he made longitudinal sections of them, and found fungus threads in great numbers perforating the epidermis of the plant in several places above the junction of the rootlets. The cells, as well as the intercellular spaces of the tissue, were invaded, and the delicate plasma of the cells was shrivelled and coarsely granular; and by the aid of glycerine a multitude of cryptococcus cells were seen, and had the same characters as when known Urocystis grows within cereal plants. Here his investigation ended, without proof having yet been obtained of the identity of the parasitic fungus with the cyst-bearing plant, but with the important result that a form of the same type, at any rate, could be produced in rice during its growth, when watered with the cholera evacuations, (BUCHANAN, l. c.)

All the theories now given agree in assigning an Eastern origin to the poison of cholera, which is believed to have either reached this country by means of direct human intercourse, as by fomites or individual contagion; or the poison itself is assumed to be migratory, and to have come hither by a kind of wave-like extension from India.* All of the suppositions (with the exception of the *third*, propounded originally by Dr. Snow) consider the existence of certain local conditions, or of a predisposition in the inhabitants of infected districts, as usually necessary to give strength and vitality to the poison. It is also to be observed that, while each of the six opinions (seven, if we include the fungoid one) or theories just noticed is apparently supported by a large amount of evidence, direct and circumstantial, each is also equally opposed by a "considerable number of obstinate facts." All of them, however, agree in two main points—namely, that cholera is induced by a special poison, and that this poison is of foreign extraction.

But, on the other hand, there are good grounds for believing that cholera has not in the present century for the first time appeared in this country, and extended itself over the greater portion of the habitable globe. The "*cholera morbus*" of Sydenham, prevalent in his time, and the "*griping in the guts*," or "*plague in the guts*," as recorded in the mortality bills of 1665, and described by Willis, and subsequently by Dr. W. Heberden, jun., do not seem to differ in their essential phenomena from the disease supposed to be imported into this country from the East; although some believe that these descriptions of disease refer to dysentery, and not to cholera.

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* Our knowledge of the progress of cholera in Great Britain was originally contained in an official report presented by the Commissioners to His Majesty King William IV., of which only one copy existed. This was rescued from oblivion by Sir James Clark, aided by the Royal Librarian, who found it in a drawer, buried among a heterogeneous mass of papers. It is now appended to Dr. Graves's *Report on the Progress of Cholera.*

There are also abundant facts which seem to show that, under a different name, cholera was one of the most fatal epidemics by which the population of London was formerly afflicted. And there is no doubt that cholera, like every other epidemic disease, varies in its type, as it does in severity; for, if it is conceded that the diarrhœa so prevalent during an epidemic of cholera arises from the same cause, and is, in fact, the same disease in a different degree of intensity, as Orton showed in 1832, "there is as much variety in the aspect and symptoms of cholera as of scarlet fever; between the malignant cases of which and the extremely mild ones there is so vast a difference."

The principal differences shown by Mr. Radcliffe between the recent epidemic (1866) of cholera in Europe and those of former years are,—(1.) For the first time in the history of the disease, Europe was invaded from the south. In 1829-32 and 1845-48 the disease spread from Persia to Russia, and thence along the Danube into central Europe; and in Britain the towns first attacked on all previous occasions were seaports on the East Coast. (2.) A remarkable feature in the epidemic of 1866 was its rapid and great extension along the coast line as compared with its slight and sluggish penetration inland. The central districts of Europe escaped altogether during 1865, except that there was an isolated outbreak in Saxony. (3.) The progress of the disease was much more rapid than in former epidemics. In 1829 cholera took fifteen months from the time of its entrance into Europe to reach Great Britain; two years, less one month, to arrive on the North American coast. In 1848 its diffusion occupied nearly the same period of time. In 1866 the disease had in less than five months spread from Alexandria to the coasts of the Euxine, and even to the western hemisphere.

A strong point in favour of the view that in 1866 cholera was introduced from the Mediterranean by ships coming thence is furnished by the fact that Southampton was the only port at which ships arrived having had cholera deaths on board shortly before reaching England. Moreover, it had been predicted that the disease would enter the country by Southampton, and not, as before, by towns on the East Coast; and the fulfilment of the prophecy will seem to many, as Dr. Parkes observes, sufficient evidence that the outbreak at Southampton arose in this way (*Sydenham Society Biennial Retrospect*, 1867, p. 494). (4.) This swift propagation of the epidemic does not appear to have been dependent on any peculiar virulence of the disease.

The evidences of importation or transmission of the disease in this country in 1866, by human intercourse, were sufficiently abundant, and as demonstrative as possible consistent with the nature of such evidence; and there can be no doubt, as Mr. Simon concludes, that if a quarantine could be conducted with the extreme rigour and precision of a chemical experiment, cholera could be kept out of any part of Europe wherever such extremely difficult conditions could be absolutely fulfilled. England seems to have been infected in 1866 at many different points of invasion, and from many different directions, almost at the same time, as the following details by Mr. Simon will show:—

"On the 28th of April a first case was reported from Bristol—that of "a trader who had arrived there sick from Rotterdam.

"On 15th May telegrams from Liverpool and Birkenhead reported "that the disease was prevailing on board certain vessels in the Mersey, "among German and Dutch emigrants, who, with a view to crossing the "Atlantic for New York, had come in flocks, travelling rapidly from the "Continent, often from infected parts of it, by way of Hull, Grimsby, "and other of our north-eastern ports, and had now fallen ill at their "port of embarkation. Much alarm was occasioned by this outbreak; "the more as new arrivals of the same sort were occurring from day to "day. The outbreak, so far as England was concerned, soon came to an "end; but the subsequent progress of the emigrants was unfortunately "not unattended by cholera. Indeed, in several cases, vessels such as "the above, leaving in apparent health, suffered during their voyage "cholera deaths among their passengers and crew, and were of course "very dangerous arrivals for their port of destination.

"Within the next few days after the 15th, my Lords of the Privy "Council were apprised of the first two cases of what afterwards became "a serious epidemic at Swansea; and single cases in various other parts of "the country were also notified to them. Anxiety became general in the "country; and there was much correspondence with local authorities, often "on precautions to be taken against the disease, or provisions to be made "for treating it, and often on questions of jurisdiction and responsibility.

"On 15th June the Peninsular and Oriental Company's steamship "'Poonah' arrived at Southampton with a case of cholera on board, and "several other cases had appeared in the town. On the 29th two deaths "were reported by telegram to have happened at Goole, whither clearly "the disease had been imported from Antwerp. On the 30th three "deaths were reported to have occurred at Northwich in Cheshire, and on "the same day a case of cholera occurred at Shields on board the 'Clio,' "from Hamburg. On 3rd July a case was reported to have happened at "Harwich, on board the 'Redstart,' from Brussels; and on the same day, "from Brixham, the death of the captain of a coasting vessel was reported.

"A serious extension of the disease was imminent. Reports of new "centres of infection became more and more frequent; and on 14th July, "the time had come for putting the Diseases Prevention Act in force "throughout the whole of England and Wales, by which ample powers "of medical relief (not restricted to paupers) were exercisable by local "authorities throughout the country.

"On 18th July, from Poplar, the first cholera death in the metropolis "was reported. Two days afterwards there was already an alarming "proportion of cholera cases in parts of East London; and on the 21st "the secretary of the London Hospital reported that the resources of "that most useful institution were being overtasked by such claims for "admission as attested a very terrible epidemic of cholera."

At the same time diarrhœa of so severe a form as to be called "choleraic" preceded the epidemic outbreak in 1865 and 1866; and if it is found impossible to disentangle, at the beginning of an outbreak, cases of a *quasi* epidemic character from those of a *true* epidemic character, and to shut out absolutely a theory of the development of epidemic cholera by gradation out of quasi epidemic or severe diarrhœa, it is equally impossible to set aside the fact of exposure of the metropolis (and busy ports of embarkation and debarkation, like Southampton and Hull and Liverpool) to continuous transmission of the epidemic malady from the early autumn of 1865 to the early summer of 1866 (RADCLIFFE). The apparently distinct outbreaks in several towns and localities, however isolated, must all be regarded as forming parts of one general epidemic; and the histories of them, so ably set forth in the various reports collected together by Mr. Simon, Dr. Parkes, and others, compel the conclusion that the chief agents in the dissemination of the epidemic of 1866 have been the sick from the malady in its slighter, as well as more marked and characteristic forms—a conclusion which has been adopted absolutely of epidemic cholera by the International Sanitary Conference which met at Constantinople to consider the question of the preservation of Europe from this pestilence. The history of the epidemic in its entirety in this country points to the transmission of the disease to the metropolis and other ports from localities previously visited by it in Western Europe. Mr. Simon's dictum, that "*contagious currents on the Continent of Europe must be deemed virtually current in England*," is to be accepted as an axiom in State Medicine, notwithstanding that links of transmission may fail to be discovered (*Ninth Report*, p. 288). The testimony of Dr. Macpherson also is to the effect that, whatever cholera we have had in Europe in former times, since 1817 at least it has been always carried out of India, or Persia, or Arabia, to other places.

"The outbreak of cholera in the metropolis in 1866 cannot well be
"considered apart from the wide diffusion of the disease on the Continent
"of Europe during 1865 and 1866. It is inextricably linked, both
"chronologically and etiologically, with that rapid dissemination of the
"malady which, in May of the former year, commencing at the most
"sacred city of Mohammedanism, Mecca, extended to Egypt, and thence,
"before the close of the summer, to many places on the eastern and
"southern coasts of Europe, and in the basin of the Mediterranean.
"During the autumn the epidemic spread largely in the south of France
"and in Spain, appeared at Altenburg in Saxony (where it was intro-
"duced from Odessa),* and extended to several neighbouring towns, broke
"out with severity in Paris, and infected slightly our own coast at South-
"ampton. From the 24th September to the 4th November thirty-five
"individuals succumbed to the disease in the last-named seaport town;
"and from the 28th September to the 31st October nine deaths occurred
"from cholera (an off-shoot of the Southampton outbreak) at Theydon
"Bois, in Essex, a hamlet lying about eleven miles in a direct line N.N.E.
"from Bow bridge. As the winter of 1865-66 advanced, the epidemic
"extended to North-western France, chiefly affecting the departments of
"Finisterre, Morbihan, and Côtes du Nord; and throughout the cold
"season it manifested more or less activity along the opposite coast of
"the channel. In the north-east the department of the Vosges received
"the infection. With the increasing spring the disease became more

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* *Die indische Cholera in Sachsen*, 1865; Dr. Rudolf Günther, p. 9.

"rapidly disseminated. In several localities of Belgium and Holland it "early showed itself. As the summer grew, and its mid-season approached, "the diffusiveness of the epidemic augmented largely. The malady "re-appeared in several cities and towns of Eastern, Southern, and "Western Europe which had suffered from it the previous year; it spread "generally throughout the provinces of Belgium and Holland; and "extended widely in Prussia, Central Europe, and European Russia.

"The epidemic broke out in Rotterdam prior to the 21st April; in the "port of Antwerp on the 19th May; in Stettin before the 2nd June; in "St. Petersburg on the 26th June, or somewhat earlier; in Memel before "the 10th July; and in Dantzig before the 12th of the same month" (*Ninth Report to Privy Council*, by Mr. Simon).

But other and occasional circumstances are required to give energy to the development of the poison of cholera. These may be described under the two heads of "*meteorological conditions*" and "*localizing causes.*"

(1.) *Meteorological Conditions.*—Of the first of these, (high) temperature appears to have some marked influence. The average temperature of 1846, in which the mortality occasioned by diarrhœa, cholera, and dysentery was very large, was 4° higher than that of 1845, and 3° above the average of the six preceding years, and the fall of average temperature was accompanied by a corresponding fall of mortality from the choleraic and flux diseases. Dr. Barton, of New Orleans, states that cholera always co-exists there with an east or south-east wind. A temperature above 70° Fahr. increased as the disease attained its maximum, a dew-point of from 60° to 70°, and a barometric elevation of over 30°. The maximum barometer occurred on November 18, 1853, and was 30·46° (a very unusual height), soon after which cholera broke out. During December the wind continued from the east, north, and north-east; the maximum barometer was 30·48° on the 2nd, when the cholera was at its height, and declined to its minimum, 20·57°, on the 30th. The cholera ceased soon after the middle of the month.

The first epidemic of cholera in this country, during the present century, began in the north of England, in October and November, 1831. The preceding summer was unusually fine, the nights being warmer, in proportion, than the days. In November, December, and January, the atmosphere was observed by many independent observers, both on land and sea, to be *singularly stagnant, un* *usually still, close, and hot,* so that it was impossible to ventilate even large houses, in which no change of air " seemed to take place for almost a week together." According to the delicate and accurate observations of Mr. Glaisher, the meteorological phenomena of the three visitations of 1832, 1848, and 1854, appear to have been remarkably similar (excepting as to temperature). Indian medical officers, and those of the Black Sea fleet, give similar accounts as to the meteorological phenomena which attended the outbreaks of cholera, in their experience.

The chief meteorological phenomena of the epidemic period of 1865-66 have been summed up by Mr. Glaisher,* and a comparison instituted between them and those occurring during the previous cholera outbreaks. The contrast is remarkable. The visitations of 1832, 1848, and 1854 were coincident with great atmospheric pressure, high temperature (except in 1832†), small diurnal range (owing mostly to high night temperature), deficiency of rain, very little wind (and comparative stagnation of atmosphere and prevalent mist), a deficiency of electricity (indicated by the few electrical disturbances), and in 1854 "the presence of a remarkable blue mist," which prevailed night and day, and total absence of ozone.

During the three months of principal prevalence of the outbreak of 1866 in the metropolis (July, August, and September), the atmospheric pressure was remarkably low. From the 26th of July to the end of the quarter the barometer, reading at the height of 160 feet, never reached the point of 30 inches—" a most rare occurrence," as Mr. Glaisher writes.

The temperature of the air was low night and day, except in September, when the nights were warm. The daily range of temperature was small, "chiefly owing to low day temperature, particularly "in August, and to a somewhat less degree in September, but the "range in September was still further lessened by the high tem-"perature of its nights." There was an abundance of rain, and the air was in almost constant motion, "frequently blowing a much heavier "gale than usual at this season of the year." "Nearly all the circum-"stances," Mr. Glaisher observes, "are directly opposite to those "mentioned above as being present at the previous visitations of cholera,

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* *Quarterly Return of the Registrar-General,* July—September, 1866, p. 18.

† *Appendix to Report of Committee for Scientific Inquiries—Cholera Epidemic,* 1854, p. 114.

"and have probably aided in checking its wider extension." He adds, "One of the most remarkable atmospheric phenomena during the past "quarter has been the prevalence of a peculiar blue mist, first seen by "myself on 30th July, but which had been remarked by other observers "in the preceding week. This blue mist since that time has been "generally present. On some days no trace of the mist has been visible, "and on other days it has been seen for parts of a day only. It has "extended from Aberdeen to the Isle of Wight, and of the same tint of "blue everywhere. This mist increased in intensity when viewed "through a telescope; usually no mist can be seen when thus viewed: "it increased in density during the fall of rain; usually mist rises after "the fall of rain. Its density did not decrease when the wind was blowing moderately strong, but did decrease when a gale was blowing, but "increased again on its subsidence. I do not know the nature of this blue "influence; but the fact of its presence not having been noticed since "the cholera period of 1854 till now, points out a possible connection; "but, independently of this, it is of high meteorological interest."

Mr. Glaisher's observations are restricted to the September quarter; but Mr. Radcliffe extended his observations over the whole period of the outbreak in London, and especially calls attention to *two* points. The first of these is the probable effects of certain excessive variations in the temperature of the air upon the early, sudden, and large development of the outbreak; the second, the relationship of the fluctuations of the outbreak during its decline to variations of temperature; also to the deficiency of ozone during the four weeks in which cholera became active and the outbreak attained its greatest development.

The initial activity and rapid development of the outbreak in London of 1866 was preceded and accompanied by an excessive range of temperature. The mean temperature of the week ending the 30th June, in which the earliest cases of cholera occurred, was 4·8° above the mean of the same week on an average of 50 years. During the next week the mean temperature fell 5·1° below this average; but in the following week the mean was in excess 6·3°. In the first third of these weeks the range of temperature was 24·0°; and in the second, 17·5°.

It is not improbable that the great range of temperature in the last week of June and the second week of July was influential to some extent in causing the sudden development of the epidemic in other districts than the East of London during the third and fourth weeks of July and first week of August.

The relationship here suggested between the temperature and the development of the epidemic in the districts referred to is supported by the correspondence between the lagging of the epidemic during its decline and certain sudden elevations of the temperature above the mean. The rate of decline of the outbreak was much slower after the third week of fall than in previous epidemics. The epidemic lagged, in fact, and this lagging first followed and partly accompanied a three-weeks elevation of the mean temperature slightly above the average, after a four-weeks persistent fall beneath it. And it may be here observed that of the four weeks during which the mortality of the outbreak was greatest, and in each of which the temperature fell below the average, two of the weeks were weeks of rapid decline of the disease.

An augmentation of the outbreak in the last week of September and first and second weeks of August, during which the mortality in the metropolis, exclusive of the East Districts, reached its maximum, occurred contemporaneously with a three-weeks elevation of the temperature above the average; and the subsequent fall of the epidemic, near the commencement of winter, contemporaneously with a temperature maintained above the average, was sluggish. Among the facts about cholera, in India none are more clearly made out than its prevalence in different places at particular seasons. It is very plainly influenced most by the combination of influences known as "season" (MACPHERSON).

Such meteorological conditions have a marked tendency *to favour the chemical decomposition of organic substances, and to render the season defective in those atmospheric changes which, by decomposing and dispersing into space the products of decomposition, renew the purity of the air.* "The effect of temperature upon the Thames water is very remarkable in tainting the surrounding air, and is exhibited in the well-known fact that diarrhœa and summer cholera become prevalent among the inhabitants along the banks of the Thames after the temperature of the river has attained to 60°, and as the water declines from this temperature, so do these diseases in its vicinity." In Europe all the great epidemics have occurred in times of prolonged drought; and the dissemination or dispersion of the disease is very closely related to rainfall, as Dr. W. Budd, of Bristol, has shown. By diluting the poison, and by giving rise to floods which rapidly sweep it beyond the inhabited area, rain seems to have a powerful influence in checking the disease. But to have this effect the rainfall must be heavy and continuous —while, on the contrary, light and intermittent rains favour its spread.

The general result of all such observations is, " that whilst cholera may prevail within a considerable range of temperature, a moderately elevated one is most suitable for its development and propagation; and this, accompanied by a still, stagnant, and peculiarly oppressive condition of the atmosphere (more oppressive than the elevation of the thermometer can account for) and a moderate amount of moisture." With regard to the apparent anomaly as to temperature in the case of its outbreak in Moscow, and in the northern countries of Europe, such as in Sweden and Norway, it must be remembered that the internal atmosphere of the Russian, Swedish, and Norwegian houses is maintained at a high elevation during the winter months by means of stoves. It must be remembered, too, that the water used by the Russians in winter is often got from the melting of snow in the vicinity of the houses, and which snow is generally exposed to the reception of various excreta from the houses, just as the surface of the soil would be exposed. Hence the facilities for its spread in Russian hamlets.

Although meteorological statements appear to be a mass of confusion, from which we can scarcely deduce a single general principle; yet we know that organic germs, and seeds of various kinds, are capable of preservation under the most different and variable meteorological conditions; and also that particles or germs most microscopically minute are capable of actual demonstration in the air we breathe, as already stated at page 461. See also a most interesting and very suggestive paper on "*Germinal Matter and the Contact Theory*," by James Morris, M. D., Fellow of University College, London, 2nd edition, November, 1867.

(2.) *Local Causes.*—But, in order to give character and energy to the development of cholera, there are other conditions required besides those meteorological phenomena just noticed. These other conditions are described by Dr. Barton as the "*terrene element*," and correspond with what in this country have been termed the "*localizing causes*" of cholera.

That some local circumstances play a very important part in the evolution of cholera is evident from the following facts:—

1. An analysis of the history of cholera epidemics shows that they are most frequently made up of a succession of partial local outbreaks, not only in different districts, but even in the same place.

2. The pestilence has also been observed to linger in some few favourite haunts throughout the entire course of an epidemic; and that, now and then, after visiting a place at the commencement of an epidemic, it has returned to it again, after an interval of complete immunity, before its close.

3. That some places escape an epidemic visitation at the very period when others in the immediate vicinity are suffering severely from its presence, the meteorological influences being the same. Even in the same town, whilst the inhabitants of some streets or courts are being decimated, those dwelling in others not far distant altogether escape; or, as frequently happens, the inmates of certain houses suffer severely, whilst their neighbours are entirely spared.

4. That the limits of a tainted district are sometimes clearly marked out. In illustration of this, my amiable teacher, the late Dr. W. P. Alison, Professor of Medicine of Edinburgh University, quoted a most striking example in his paper on "The Exciting Causes of Epidemics," in *The Medico-Chirurgical Review* for 1854. He wrote (on the authority of Ashton Bostock, Esq., Surgeon of the Guards), that *one* wing of a cavalry regiment, just arrived from England, and in high health, ascended the Ganges from Calcutta in boats, there being no cholera at the time in Calcutta. At a certain period of the voyage the troops arrived at a part of the country where cholera prevailed in the villages on the banks of the river, *but with which they did not communicate.* Here cases of cholera occurred in the boats; the men were advised to push on rapidly, and after a few days, when they had passed the limits of the existence of the disease on the banks, it ceased to show itself in the boats. What makes the case peculiarly conclusive is, that the other wing of the regiment followed afterwards by the same mode of conveyance, became "*affected with the disease at the same point, and lost it again at the same point.*"

Although very great differences of opinion prevail as to the part which obvious local causes of insalubrity bear in the production of cholera, yet it is almost universally considered that they are necessary for the development and propagation of this disease in its epidemic forms. Drs. Barton, Carpenter, Pettenkofer, and Snow, all agree in this general proposition. Pettenkofer, of

Munich, maintains that a certain condition of soil is necessary to the local development of epidemic cholera. It must be pervious and permeable to water and air. It must possess a particular degree of *humectation*, depending upon the position of the subsoil water to the surface. It must be charged with organic, especially excrementitious, matter. These he believes are essential conditions, *as to soil*, for the development of epidemic cholera. The nidus, or cholera poison, or cholera *ejecta*, once finding admission to such a soil, undergoes those developmental changes which ~~is~~ are characteristic of its rapid dissemination as an epidemic. Such a condition of soil fosters the multiplication of the cholera poison. It does not generate the poison *de novo*, but by means of the evacuations of those sick of the disease the fermenting contents of choleraic intestines find their way into such soils; and the aptitude for the multiplication of the poison by specific fermentation is in accordance with a certain state of *humectation* of the soil, which again has a definite relation to the recession of the subsoil water after it has approached unusually near the surface.

But apart from the local conditions as to soil insisted on by Pettenkofer, there is very strong evidence to show that the decomposing choleraic discharges (already in a state of active fermenting change in the intestine of the cholera patient) will produce the disease—which will go on changing and multiplying a virus capable of spreading through the air as well as through the medium of water. In the outbreak at Southampton in 1866 there were instances both of transmission by water and by air (Parkes, in Mr. Simon's *Ninth Report on Public Health*, p. 253). The discharges need not pass into the ground to decompose or ferment there. They can decompose equally well in sewers, and, of course, can propagate their specific fermentation to the contents of such sewers, and such contents may find their way as gases or more material elements in the air or in the water.

Impure water, lowness of sites, and *the emanations arising from the decomposition of animal refuse, or of excreta,* are the local causes now satisfactorily determined to have a more or less constant connection with the development and propagation of cholera.

That *impure water* has a powerful influence over the intensity of cholera outbreaks is now unquestionably established by the observations of Drs. Acland, Sutherland, William Budd, Parkes, and the late Dr. Snow, and the specific inquiries of the Registrar-General and Mr. Simon. Yet still it is found that *impure water* is not a necessary element in the generation of the cholera poison, as shown in the report of Dr. Baly (pages 201-205), Budd as to Bristol, Pettenkofer as to Munich, and Günther as to Saxony. From their evidence, "cholera can do its very worst where the drinking water can play no possible part in its dissemination (*Brit. Med. Jour.*, April 13, 1867, p. 416).

The localized attacks at Theydon Bois in 1865, in the east of London and in Southampton in 1866, all point unequivocally to impure water. With the *general outbreak* at Southampton, however, impure water had nothing to do. It had only to do with the production of the disease on board the steamship "Poonah" just before her arrival from Gibraltar, where she took in a tankful of very foul water, which, from its peculiar smell, evidently contained sewage (PARKES).

As regards London, it has been shown by Dr. Farr that *the elevation of the soil* has a more constant relation to the mortality from cholera than any other known element, the mortality from cholera being in the inverse ratio of the elevation. Yet, like the condition of the water, the elevation of the soil has not been always found to be a necessary localizing condition; and there is now only left to be noticed *the influence of an atmosphere contaminated by the effluvia arising from decaying animal matter and excreta.* Dr. Cullen long ago remarked, and every industrious dissector knows, that the effluvia from very putrid animal substances readily produces diarrhœa. Yet it appears that the nature of the decomposing matter, and of the transforming process it undergoes, have some influence in modifying the effects on the human constitution. Districts in which the most putrid odours tainted the air have sometimes almost entirely escaped, whilst others contiguous to them have suffered severely. Dr. Chisholm (quoted by Dr. Alison in his paper already referred to) gives numerous pointed illustrations of this, in the cases of "bone manufactories," "manufactories for the conversion of dead animal matter into a substance resembling spermaceti," "of places where blood is putrefying, waiting to be used by sugar refiners," and "of leather-dressing establishments." In dissecting-rooms, where the process of animal putrefaction goes on to a great extent, diarrhœa is comparatively rare, if the rooms are kept clean. During my experience, as Demonstrator of Anatomy in the University of Glasgow, for a period of six years (including the severe epidemic of cholera there in 1848-49, and during which time almost all the subjects for dissection had died of cholera), not a single student suffered from cholera; and when the proper agents are used, such as the injection of arsenical solutions into the dead body, which have the effect of arresting and modifying the putrefactive changes, I believe the production of diarrhœa is an exception, and may be found to have as significant a cause in errors of diet or of drink as in too close an attendance in the dissecting-room. That the poison of cholera does not attach itself to the *dead body* (in a certain state of decomposition at least) is a fact confirmed by the experience of those connected with the dissecting-rooms in Edinburgh. It is certain that these were supplied during the greater part of 1848-49, as they were in 1832, almost exclusively by cholera subjects, and in neither year was there a single case of the disease among the numerous students attending these rooms (Dr. ALISON).

Much pains has been taken by Dr. E. H. Greenhow to investigate the precise conditions which, from their more uniform co-existence with cholera, might be supposed to produce or to aggravate epidemics of it. The result of his observations tends to confirm what Mr. Orton (*London Med. Gazette*, vol. x., p. 222, 1832) was the first of English writers to show—namely, that "an atmosphere impregnated with the products of *fermenting excrement* is at once the most obvious and most constant concomitant of cholera (*the privy or fæcal contamination theory*). Such exhalations were often found, even in a concentrated form, in houses where the existence of any palpable cause of insalubrity would scarcely be suspected, and thus the fact is in some measure explicable, that the pestilence, sometimes passing over slums and rookeries, knocked at the door of the comfortable annuitant or the wealthy tradesman. It was found that persons appeared to suffer in proportion to the contamination of the air they breathed with the '*privy odour*,' and that immunity from this appeared to secure immunity from cholera." The observations of Mr. Orton and of Dr. Greenhow are confirmed by the investigations of Dr. Pettenkofer at Munich and at the village of Gaimersheim. Dr. Barton, of New Orleans, Dr. Milroy in his report on the epidemic at Kingston, Dr. Buckler in his account of the outbreak in the Baltimore alms-houses, and Dr. Parkes at Southampton, give similar evidence confirmatory of the injurious influence of the *fermentive decomposition of animal excrement.*

The outbreaks of cholera in some of the camps in Bulgaria and the Crimea, especially at Aladyn and Alma during the war, also furnish sufficient illustrations; and I believe the outbreak of cholera at Scutari, in November, 1855, which suddenly commenced in the camp of the Osmanli Horse Artillery, had a similar origin.

Propagation of Cholera by Human Intercourse.—When cholera appeared in its epidemic form in this country in 1831, the majority of European practitioners were decided contagionists. Subsequently to that period a re-action of opinion occurred, and the question was discussed for many years without any definite result. In 1848, when the disease again became epidemic, many of the higher authorities coincided with "the solemn declaration of the Board of Health, that the malady was not in any way contagious, and that no danger was incurred by attendance on the sick. "A large body of evidence, however, now renders it certain that human intercourse has at least a share in the propagation of the disease, and under some circumstances it is the most important, if not the sole, means of effecting its diffusion" (Dr. Baly). Very positive evidence has now accumulated in abundance to prove the transmission of the disease by human intercourse. Healthy men carry the disease with them by their clothes, by their ships, and by their caravans. That such is the case, we have now ample evidence in the *Bengal Report,* of 1824, by Dr. Jameson; in cases related by Mr. Orton, in 1832, and by Dr. J. Y. Simpson, in 1838; in *The Edinburgh Monthly Journal* for 1849, by the late Dr. Cruickshank, at Dalmellington, in Ayrshire; by Dr. William Robertson, detailed in *The Edinburgh Monthly Journal* for August of that year; and more recently the account of the outbreak at Arbroath, in Scotland, in 1853, by Dr. T. Trail; and cases by Dr. Alison, in 1854, in the paper already noticed; in the report of Dr. Berg, of Stockholm, in 1848; in the Norwegian Reports of 1850-53; in the Report of the College of Physicians of London, in 1854, and the several reports of 1865 and 1866. These records afford undoubted instances which show that human intercourse is occasionally influential, in some way, in transmitting cholera into detached localities, where it may seize upon two or more individuals, and then cease. But it is no less certain that its general extension over the world cannot be accounted for by human intercourse alone, to the exclusion of aerial contamination. It is curious that in India, the birthplace and headquarters of the disease, the doctrine of contagion is almost universally disbelieved in by our professional brethren. The opinion generally entertained in India is opposed to the doctrine of contagion (Morehead, *Indian Annals of Med. Science*, vol. i., p. 456). Such difference of opinion may admit of explanation in the fact that in India all the causes of cholera in its original home are in constant operation, and more especially prolonged heat, decomposing organic matters, a more or less debilitated state of the European constitution; and hence, no sooner is the poison or germ of cholera imported than the disease spreads with such rapidity as to resemble an epidemic invasion. Cases, however, of undoubted contagion are not wanting in India. Mr. Barry, of the Bengal service, records an outbreak of cholera at Gowalparrah, in Upper Assam, in 1853. In this instance cholera was evidently imported into a healthy place by a body of Sepoys coming from an infected locality. Every case of the disease could be traced to communication with the sick: a large number of attendants on the sick were seized, but those who separated themselves escaped in every instance (*Ind. Annals*, vol. i., p. 448. See also the instance of Dominica, twenty-two miles from Guadeloupe, referred to by Mr. Simon in the *Ninth Report of Public Health*, pp. 25 and 26. Also those referred to in the *Army Medical Departmental Report* for 1865, p. 349, given by Dr. Parkes from Dr. Günther's work on the Cholera in Saxony).

According to the accurate observations of C. T. Kiërulf in the vicinity of Bergen, it appears that, when the disease is propagated by human intercourse, from one to four days elapsed from the supposed period of infection to the outbreak of the disease. (M) Most frequently the disease appeared on the second day after exposure to the infection; and he found that the diarrhœa, so frequent during the invasion of cholera, is a part of the disease, and itself capable of infecting others with true cholera. This, Mr. Orton also showed, was the case in 1832, (l. c.) The extreme shortness of the period of incubation is an important element to be remembered in all investigations regarding the course of events in

Incubn period 6 hrs — 3-4 days

cholera epidemics. According to Dr. Budd's observations it seldom exceeds three days; and where the disease is virulent, there is evidence to show that it may not exceed six hours.

The inoculation experiments of Namias with needles loaded with the evacuations from cholera, and the experiments by tasting the vomited fluids by M. Foy and his coadjutors, have given entirely negative results. So also the influence of exhalations from the blood and evacuations of patients with cholera, as designedly experimented on by inoculation, has been of a negative kind. On the other hand, Lauder Lindsay, Marshall, Thiersch, and Meyer, have succeeded in communicating cholera to dogs and cats and mice, chiefly through the *rice-water* evacuations from cholera patients being swallowed by these animals.

Dr. Wm. Budd, of Bristol, maintains, with most cogent reasoning and evidence, that the poison is cast off by the intestine of the cholera patient in the characteristic rice-water discharges, and that it may be transmitted to other and uninfected persons in the following principal ways:—

1. By the soiled hands of attendants on the sick;—a mode of communication probably very common within the limits of the family circle.

2. By means of bed and body linen, and other articles tainted with the rice-water discharges.

3. Through the medium of the soil. The discharges being liquid, the great bulk of them find their way to the ground, from which the poison may be propagated in three ways,—(*a.*) By rising into the air as a product of evaporation; (*b.*) By percolating into the drinking water; (*c.*) By atmospheric dispersion in the form of impalpable dust, after it has passed into the dried state. It is, of course, difficult to establish these modes of propagation by direct proof; but circumstantial evidence, and evidence by analogy, is so cogent and weighty, that no reasonable doubts can now be entertained regarding these modes of propagation. By *experiment* the *enthetically* contagious poisons (*e. g.*, vaccine variola, woorara, &c.) are known to retain their properties in a dormant state for indefinite periods of time after having been dried up, and to recover these properties again when moistened. Evidence almost as certain as experiment demonstrates the same regarding the poison of scarlet fever, malignant pustule, glanders, and syphilis. Therefore, it is probably true of cholera, and the

more so that the numerous and well-authenticated instances of the propagation of the disease through articles of dress shows that the poison, during its transit, must necessarily have been in a dried condition—a condition which entirely protects organic bodies from certain molecular changes; so that, so long as the material-holding poison remained in this dry state, no definite limit could be stated as to how long the morbific agent might retain its specific powers. From this point of view a single case may give rise to a wide-spread infection; and as cases multiply, it becomes more and more impossible to trace their lineal succession.

The relative share which the modes of propagation (here indicated by Dr. Budd) take in the propagation of cholera must vary with season and climate, with temperature, with the habits of the people, with the nature of the soil, with the water supply, with the prevailing wind, and with general sanitary arrangements.

The experience of 1866 and of 1865 confirms all previous experience as to the propagation of cholera, so well summed up by Mr. Simon in his official memorandum of July, 1866. In it he assured the public that cholera is so little contagious, in the sense in which small-pox and typhus fever are commonly called contagious, that, if proper precautions are taken where it is present, there is scarcely any risk that the disease will spread to persons who nurse and otherwise closely attend upon the sick. But he admits it is not less true, that all matters which the patient discharges from his stomach and bowels are infective; that the patient's power of infecting other persons is due entirely, or almost entirely, to these discharges; that these, however, are comparatively non-effective when first discharged, but afterwards, while undergoing decomposition, acquire their maximum of infective power; that, if cast away without previous disinfection, they impart their own infective quality to other excremental matters; that if they get access, even in the smallest quantity, to wells or other sources of drinking water, they may infect very large volumes of water; that the infective influence of choleraic discharges attaches to whatever bedding, clothing, towels, and like things have been imbued with them; and that thus even a single case of cholera may exert a terrible power over large masses of population, *if local circumstances co-operate.*

The rapidity with which the rice-water discharges must pass into a dry state under the burning rays of a tropical sun, renders it highly probable, as Dr. Budd suggests, that in India "dust," bearing the poison of cholera in a dry state ("cholera dust"), has a large share in the mode of propagation; and when the disease has prevailed, the poison may be left behind in a dormant state, from being simply dry, so that seeds of a new outbreak may exist in the soil co-extensive with the first. Hence the imprudence of encamping on old encamping grounds (to which I have so often referred); and, in short, these views of Dr. Budd appear to explain, in the most natural way, almost all the leading facts which characterize the diffusion of the pestilence. They explain especially the relation of cholera to filthy habits and defective drainage—its predominance in low levels—its striking tendency to follow the natural line of water-shed—its communication to persons who not only have never been in the presence of the sick, but who are stationed at a distance from them—contamination of those only who visited one particular or single privy, into which the rice-water evacuations had been discharged from the first casual case—and the operation of tainted privies in propagating the disease in workhouses, barracks, prisons, and places of public resort (Dr. Budd's Letters addressed to the *Association Med. Journal* in 1854-55; Dr. L. Lindsay's able papers; and Dr. Alison's paper "On the Communication of Cholera by Dejections," in *Edin. Med. Journal,* 1855; also Mr. Simon's *Ninth Report,* for 1866). Under circumstances, therefore, of great concentration, or otherwise, some unknown poison is communicated, probably by *fomites,* through human intercourse; and as emanations, of some kind or other, passing through the air, they act as poisons on the gastro-pulmonary mucous membrane of susceptible persons. Dr. Parkes has shown, in his Indian experience of cholera, that it may pass with extreme slowness even against the wind (and even the trade or monsoon wind), which only retards its course, but that a favourable wind promotes its transmission; and that it sometimes travels in this way, and not by the shortest route of human intercourse, or even by the route of greatest intercourse between places.

The communication of cholera by the so-called premonitory diarrhœa (*i. e.,* the early stage of cholera) is now beyond dispute. "An instance in point occurred at Southampton in 1866, where " no cholera prevailed at the time. A man in the diarrhœal stage " of the disease landed at Southampton, and went to his house, a " clean airy place, where his wife and young child lived. He was

Cold Stage 12 – 24 – 48 hrs or +
Febrile 4 – 8 days or +

" labouring under great diarrhœa when he landed on Monday. On " Wednesday following his child was attacked with cholera, and " died on Thursday; and on Thursday the man became worse, " and died of cholera on Friday." Here the observations of Parkes confirm the observations of C. T. Kiërulf, near Bergen, and of Mr. Orton in 1832, already referred to.

Symptoms and Various Forms of Cholera.—*Cholera Indica* has many degrees of severity, and hence many pathologists have divided it into *Cholera Indica mitior*, and into *Cholera Indica gravior*. The French have termed the slighter forms of the disease *Cholerine*, and this name has been also recently used by Dr. Farr to designate the specific poison or zymotic matter of cholera.

Malignant Cholera is divided into two stages,—the cold, pulseless, or asphyxiated stage, and the febrile stage, when the patient outlives the first. This latter stage, however, is not essential to the disease, and has been observed in India in a small proportion of the cases only. In Europe, however, the febrile paroxysm has followed in the majority of instances. The duration of the cold stage varies from a few minutes to twelve, twenty-four, forty-eight, or even more hours; while the febrile stage lasts from four to eight or more days,—making the total duration to vary from a few hours to two, three, or even four weeks.

The attack of this fatal epidemic is most commonly sudden, the patient at the time of his sickness being apparently in his best health; yet not unfrequently slight diarrhœa or other general indisposition has preceded it. In India, in some cases, the premonitory symptoms are vertigo, noise in the ears—the latter sometimes so loud as to have been compared to the humming of a swarm of bees, to the beating of drums in the camp, or to the roaring of the surf on the Coromandel coast.

A classification may be made of the disease into three principal varieties, which coincide in their phenomena with many of the changes known to take place in the blood (PARKES).

1. The slighter forms commence with much watery purging and vomiting, and pass into the second and third varieties in varying times. There may be from ten to fifty copious watery stools, and frequent copious vomiting, before there is any great loss of heat and failure of circulation. When purging commences twenty-four hours, or two or three or four days, before the violent symptoms, such as vomiting, purging, or cramps, such patients are said to

have "premonitory diarrhœa." But there is always some degree of loss of heat and failure of circulation even in the slightest cases, else the case would be mere watery diarrhœa, attended only by exhaustion, and not by the symptoms peculiar to cholera. Cramps are seldom present till the stools put on the true choleraic character—viz., of copious white flocculi suspended in a watery fluid. The algide symptoms come on gradually, and are less intense than in the following forms; recovery is also more common. In the recent epidemic in London (1866), Dr. Sutton gives forty-one examples in which there was undoubted premonitory diarrhœa, the duration of the diarrhœa being as follows:—In three cases, 12 hours; in one case, 18 hours; in one case, 19 hours. In seven cases, 1 day; in one case, 1 day and 9 hours; in twelve cases, 2 days; in six cases, 3 days; in two cases, 4 days; in two cases, 5 days; in one case, 6 days; in one case, 7 days. In two cases, 2 weeks; in one case, 5 weeks; and in one case, 8 weeks. In more than half the number of cases the diarrhœa preceded the marked symptoms by one, two, or three days; and of the forty-one cases, the diarrhœa in twenty-six was limited to the first three days.

2. If the poison acts with greater intensity, we have the second variety, in which there is less physical alteration in the fibrine, and the circulation is carried on for a longer time. Consequently, the characteristic change is not evidenced solely or chiefly in the interior of the vessels; but is partly transferred to the exterior of the vascular system. The albuminoid constituents, fibrin, and perhaps albumen, are effused in large quantities, and in all parts of the body, though chiefly on the free surfaces of the skin, alimentary mucous membrane, and more rarely the bronchial mucous membrane. The general nature of this effusion forms two characteristic distinctions between cholera and diarrhœa; for diarrhœa is a disease confined, in the first instance, to the eliminating part—viz., the large or small intestines, as the case may be—and is unattended, as a general rule, by the effusion of albumen and fibrin. The worst forms of this variety are seen in those cases in which, after two or three choleraic stools, severe and long-continued cramps come on, accompanied and followed by intense algide symptoms: after death the small intestines are generally found distended with the thick, white, flaky substance. Other cases of this variety present infinite modifications in severity, accord-

ing as watery elimination is added to effusion of the fibrine; in other words, according as they tend towards the slighter forms.

3. Thus, if the final change at once occur, and there is a complete and rapid arrest of the circulation, either from the intensity of the cause or from constitutional predisposition, the worst variety is produced, in which "a mortal coldness comes on from the beginning." As the circulation is soon almost entirely arrested by physical alterations in the blood—presumably, changes in the fibrin—there can be little purging and comparatively little sweating; there is always some effusion of the thick white substance into the intestines, but often little of the watery part of the blood. The symptoms might be inferred from a statement of this condition; we might have presupposed a very rapid loss of animal heat, loss of voice, deafness, and vertigo, total arrest of all secretions, defective aëration of the blood, consequent dark colour of the surface, and early and deep coma.

The more usual course of the disease in this country, when limited to the cold stage, is as follows:—

After the patient has been troubled for a few days with diarrhœa (the more insidious and dangerous because it is *painless*), but more commonly while he is yet in perfect health, and has retired to rest, and has slept soundly till the middle of the night, or even till early morning, he is suddenly seized with an unaccountable sickness and vomiting, together with a most profuse discharge from the bowels. More persons were seized from twelve o'clock at midnight to three o'clock in the morning than at any other time (Dr. Sutton, *Health Report*, p. 371, for 1866). These profuse evacuations are attended with severe pains down the thighs, and more especially by an indescribable and subduing sense of exhaustion, the patient often fainting in the water-closet. In an instant the physical powers of the body are not only exhausted, but its temperature sinks rapidly below the natural standard. An icy coldness benumbs it; while the skin is sometimes rendered so insensible that it has been known to resist even the action of boiling water or other powerful chemical agents. The breath, as it issues from the mouth, communicates a glacial sensation to the back of the hand; still, notwithstanding this great loss of temperature, the patient complains of being oppressed, and is incessantly throwing off the bed-clothes; while cold water, copiously and eagerly drank, is grateful to him; and, although it does not seem to afford relief to his insatiable thirst, it ought not to be withheld.

The extreme coldness of the first stage is further accompanied by a blue, livid, or purple discoloration of the hands and feet, extending not only a considerable way up the arms and legs, but sometimes over a great part of the body. These parts often become, in a few minutes after the seizure, not merely shrunken, but singularly wrinkled, like the hands of a washerwoman after a day's hard labour. These symptoms are rendered still more distressing by the shrieks and groans of the poor sufferer, often tortured by spasms, which affect the fingers, the toes, the arms, and the legs—spasms which clench the jaw, fix the walls of the abdomen in contact with the spine, or draw the trunk into singularly contorted forms. The patient thinks he obtains some relief by the use of friction, and his cries to his attendants are incessant to "rub hard."

As the disease proceeds, the countenance assumes a character peculiar to this great struggle, the "*facies choleritica*," the eye being deeply sunken, red, and injected; while the aqueous humour, transuding its coats, leaves the cornea flat and depressed as in the dead body; a broad and livid band encircles the lower portion of the orbit; every feature, moreover, is sharp and pinched, as after a long wasting disease; the complexion thick and muddy; the lips and tongue purple. All these great changes have been known to take place in a few minutes.

In addition to this sad state, the vomiting is constant, the purging most incessant, and the pulse, though often natural, sometimes rapid, yet in some cases is not to be felt, even from the first moment of the attack, either in the large superficial arteries or at the wrist. The voice is strangely altered; its firm and manly tone changes to a low, feeble, and unnatural sound. The urinary secretion is likewise entirely suppressed, while no bile flows into the intestines. The only organ which seems to preserve its powers is the brain; and the patient often to the last moment of his life retains the power of thinking, and of expressing his thoughts distinctly, sometimes full of hope, while at other times he seems indifferent to the fate which too often inevitably awaits him.

The symptoms characteristic of the collapse stage during the late epidemic (1866), according to Dr. Sutton, in the Cholera Hospital and in the London Hospital, corresponded with those witnessed in other epidemics. "The pulse was only just perceptible—that was with great care—or the patients were pulseless; the extremities were cold; the tongue was very cold, sodden, coated with thin white fur; marked lividity, especially in adults; old people and infants were, as a rule, less livid; the voice was reduced almost to a whisper; the eyes were sunken, pupils dilated, conjunctiva white and glassy; hands sodden and shrivelled; the patient restless, turning from side to side, with the eyes for the most part wide open, or closed only for a few moments at a time; very wakeful; excessive thirst, to such a degree that little children would get out of their beds and go and place their mouths under the water tap; cramps in the calves of the legs, extending up to the thighs and walls of the abdomen, in exceptional cases into the upper extremities. The patients manifested a great indifference as to their condition. When the patients were in extreme collapse the purging often ceased, and that in some cases for some hours.

"In the worst cases of cholera the vomiting and purging began suddenly and violently, went on rapidly, the algide symptoms set in very early, and there was very little and often not any purging during collapse" (*Ninth Report on Public Health*, p. 381).

On the accession of the spasms, the vomiting, and the purging, the disorder is fully developed, and the crisis is at hand, which in a few hours must decide the fate of the patient. The termination may be favourable or unfavourable: if unfavourable, he may die with all the symptoms just narrated strongly marked; or, should it be favourable, they may abate, and a happier prognosis be formed. Unfortunately, however, it too often happens that, although the stomach retains what is taken, and the purging appears checked, and the patient falls into a dose, yet the weakness, the entire cessation of the pulse, the coldness and lividity of the surface, and the ghastly expression of the countenance, show that a few hours must close the scene, often with so little struggle that death is only marked by the phenomena of cadaveric contraction, which sometimes continues active in the muscles for some hours after death. The largest number of deaths take place betwixt the hours of 7 and 11 A.M., and between 7 and 11 P.M., both with respect to males and females, (SUTTON, l. c.) These might be considered as the critical hours; and a true knowledge of such times would be of the utmost importance in the treatment, and especially the expectant treatment of the disease. The aim of expectant medicine is not simply to stand by and do nothing, but it is to watch the disease—to see if it is running its "natural" course—to judge whether the patient tends to do well; and if not, to ascertain how he tends to die, and to strive to counteract such tendency, and thus to gain time. It is very important, therefore, to know the hours when the vital powers are likely to be very feeble, and the vital functions almost brought to a stop: we may then assist the struggling patient at these particular times. "In any future registration of such facts," writes Mr. Simon, "it would be desirable to make separate enumeration of deaths in collapse, as distinguished from deaths in re-action and fever. Of course, too, in discussing the subject of hour of death, regard must be had to the hour of so-called 'attack'—*i. e.*, the hour of manifestation of severe symptoms; and if this should seem to be governed, at least locally, by some general law, the determining influence of local modes of life would need consideration."

If the patient should happily survive the cold stage, the disease may terminate by a rapid recovery, or it may pass into the second or febrile stage. The former is the more usual course in India, the latter in Europe. The first symptom of returning health is shown by the patient falling into a sleep of unusual soundness, during which the respiration becomes light and easy, the pulse freer, while a gentle, warm perspiration bedews the whole body. This grateful pause in the disease appears to be the result of the returning powers of life, uninfluenced by medicine, for it often occurs where none has been given. After this balmy slumber the patient awakes refreshed, and often recovers so rapidly that, in the natives of India, it almost resembles a restoration after syncope. In all the presidencies, indeed, and especially in Bengal, the recovery of the European has, in general, been followed by a stage of re-action, usually slight, but in some cases assuming the form of the bilious remittent fever of the country, and which has occasionally terminated fatally.

In Europe, restoration after the cold stage, and without febrile re-action, is by no means so frequent or so rapid as in India. Sometimes the re-action is trifling, and sleep may indeed have ensued, fæcal evacuations containing bile may have passed, the urine may again have flowed, the purging, vomiting, and spasms may have subsided, the pulse may have risen, the blueness may have disappeared, and the temperature of the body may have increased, yet in many instances this amelioration of the symptoms has been only temporary;—the patients relapsed and died.

In most cases, however, the re-action was more considerable, and the patient, in a few hours after the subsidence of the cold stage, laboured under a severe form of fever, in no degree dissimilar to, and not less fatal than, typhoid fever. These *typhoid* symptoms, common in Europe and America, are said to be unknown, or nearly so, in India, where, if a secondary fever ensues, it assumes the form of the remittent fever of that country. But remittence is characteristic of typhoid fever; and this character may only be more expressed in India than in Europe. For the first few hours after the febrile re-action commences the tongue is white, but it quickly becomes brown and dry, while black sordes incrust the teeth and lips. The eye becomes deeply injected and red, the cheek pale or flushed, the pulse rapid, and the temperature of the body a little above the natural standard. The patient, either delirious or comatose, then lies in a state resembling the last stage of the severest typhoid fever of this country. This struggle usually lasts from four to eight days, when the symptoms either gradually yield or death ensues. In a few mild cases the fever assumes an intermittent type, or sometimes a quotidian, sometimes a tertian form: all these cases usually recover. Such is a general outline of the symptoms of this formidable disease.

The blood in cholera varies according to the stage of the disease. In the cold stage it is usually of an unnaturally dark colour and thick consistency, so that it flows with difficulty from the veins, and very imperfectly separates into clot and serum. Blood taken from the temporal artery has been found equally black and thick. After the secondary fever is formed, the quantity of serum increases, till at length it is much more abundant in the blood than natural; and it is singular that this takes place notwithstanding that the secretion of urine is re-established.

Duration of the Disease.—It is of importance to determine whether the cholera process is limited in its duration. Dr. Sutton has attempted the observation; and finds that while the "cold stage" is always present more or less, the "hot stage" may be absent, and is no essential part of the disease. It varies very much when present. In mild cases it is very short and scarcely appreciable. In severe cases it is long and protracted, at least in this country. The phenomena of collapse appear not to be limited to any definite time. Some patients became collapsed very early; others not until vomiting and purging had continued several hours, and was then often *not* protracted. In the milder cases the algide symptoms were scarcely, or even not at all, marked; and all experience has shown that the collapse of cholera is not always present.

Dr. Sutton then endeavoured to ascertain what period elapsed from the time when a patient was seized with the characteristic symptoms of the cold stage—the violent symptoms—to the time of his entering re-action. He finds there are good reasons for believing that the *cholera process* runs a definite course of from twenty to thirty hours.

NB

Relation of Vomiting and Purging to Algide Symptoms.—When patients went into collapse the vomiting and purging very greatly diminished, and in some cases entirely ceased; and some of the worst cases—cases which seemed almost sure to prove fatal—had very little, and often not any, purging. Thus cases characterized by the most continued purging and vomiting were not by any means the worst class of cases—for the most part the very opposite. It was the exception for such cases to pass into collapse; and if so, the algide symptoms came on slowly.

It by no means follows, because a patient is very much purged, and vomits violently and very frequently, that he is in a worse condition than another patient who vomits and is purged much less. Dr. Sutton brings forward evidence which clearly shows that the algide symptoms were not in regulated proportion to the frequency of the vomiting and purging. He shows that a patient may be purged hour after hour, may almost continually vomit, yet may not pass into collapse; whereas another patient is purged and has vomiting for two or three or five hours, and passes into deep collapse. If the collapse be dependent solely on the loss of fluid, it is difficult to understand why in the very class in which there is the protracted purging there is the least collapse; and even on the assumption that one patient passes in two or three evacuations more water than another does in double the number, and admitting that it is so in some cases, we are yet called upon to explain how it is that a patient who is not purged at all—that is, has had no discharge from his bowels—dies very suddenly; that another who has only been purged four times passes into collapse and dies; while others are purged twenty or thirty times without ever showing any well-marked symptoms of collapse. It is difficult to conclude that one patient passes more fluid in one evacuation than another does in twenty; and any explanation of this difficulty, to be satisfactory, must take into consideration not only the quantity of fluid withdrawn from the blood, but the rapidity with which it is withdrawn.

In the worst forms of cholera a considerable quantity of water and other constituents of the blood are withdrawn very suddenly from the system; and there seems to be a decided relation between the severity of the collapse and the rapidity and violence with which the cholera process sets in and is carried on.

Evidences of Re-action.—When a patient dies in advanced re-action, or was in complete re-action at the time of death, the different organs of the body regain their weight, sometimes even weighing heavier than usual. This is especially the case with the lungs. In collapse the lungs and spleen weigh much lighter than normal.

In favourable cases of re-action the wakefulness characteristic of true collapse gives way gradually to sleep. The colour returns, the pulse becomes distinct and more perceptible, and in some cases the patient may sleep quietly for some time.

The thermometer, in the experience of Dr. Sutton, is of all *single* guides the best, but cannot be absolutely relied on, unless the temperature in the axilla be very low indeed, and in the rectum very high: *e. g.*, if the temperature in the axilla be 92° Fahr., and in the rectum 102° Fahr., the patient is still in collapse; but if the temperature in the axilla were 95° or 96°, imperfect re-action may be commencing. Some parts of the body appear to pass into re-action before others; and imperfect re-action is sometimes associated with bloody evacuations; and if a patient is pulseless, but with a natural colour and a greasy perspiring skin and a coated tongue, he will in all probability pass bloody evacuations, and then will certainly die. Dr. Sutton thus recognizes a class of cases having the following symptoms:—The patient is seen lying on his back, eyes open, looking very wakeful, mind collected, voice weaker than natural, at times the typical choleraic voice, colour natural, lips natural, complexion greasy, tongue sometimes cold, livid, of grey colour and covered with white fur; at other times the tongue is warm and coated with yellow fur. The hands are of a livid red colour, cold, and shrivelled. The temperature in the axilla is generally lower than usual. Respiration is laboured, and generally accelerated—often 25, sometimes 40, a minute. The pulse at the wrist may be only just perceptible, and very often such patients are pulseless; there may be no purging for hours together, and very little vomiting. There may be profuse perspiration, the face and hair wet with it. The patient may lie for hours like this, and even one or two days. Such bloody evacuations appear on an average about twenty-eight hours after the violent symptoms of cholera set in.

When the algide symptoms are most severe the re-action is greatest and most protracted. The longest re-action was seventeen days, the shortest sixty hours, in Dr. Sutton's experience. In the mild cases the longest re-action was seven days and the shortest twelve hours. The duration of suppression of urine is also in proportion to the severity of the algide symptoms. In one case no urine was passed, and none discovered in the bladder, for six days and ten hours; in two cases none for five days, and in two none for four days. In the milder class of cases three days was the longest period of suppression, and the shortest ten hours.

Chemical Changes undergone by the Body in the Progress of Cholera.—Dr. J. L. W. Thudichum, at the instance of Mr. Simon, made important observations during the epidemic of 1866, which are published in Mr. Simon's report of that year. The following is a summary of his results:—

The blood after death during collapse contains urea in variable abundance. The rice-water-like evacuations contain butyric acid, and yield nitrogen and carbonic acid, but no urea. In bodies dead at an early period there was no urea; and more seemed to accumulate after a protracted algide stage, and much more after three to six days torpid condition; and the greatest amount of urea was found after a long algide stage, with rise of temperature at the end.

X *The secretion of bile* is completely arrested; and in extreme cases a clear white fluid percolates through the hepatic ducts, free from bile, colouring matter, and albumen. It seems to be simply water, with a trace of alkali and a vestige of mucus. In some instances the fluid is coloured, but contains no bile acids. The bile-ducts shed their epithelium.

The blood loses water, albumen, and salts, and is incapable of passing the capillaries with the usual freedom. It retains most of its colouring matter in its normal chemical composition; and Dr. Thudichum's observation led to the conclusion that any fermentation of the blood was very improbable in the manner in which the intestinal contents are fermented. The blood absorbs water from the tissues; and there is no chemical evidence of any special cholera poison in the blood. The epithelium of the inner surface of the blood-vessels becomes detached and mixes with the blood, and the blood adheres to the blood-vessels with great pertinacity.

The Epithelium.—Death and desquamation of the epithelia pervades the entire surface where epithelium exists.* *The tissues* generally are doughy to the feel, from want of water. The muscles become dry and are affected with cramps; the spasms, beginning at the most distant parts, rise gradually to the centres; and the cramped muscles show deposits; urea accumulates in them, and nuclei of their sarcolemma multiply.

Intestinal Contents and Rice-water Evacuations.—The contents of the colon half an hour after their removal were observed to evolve gas, and to lift off the heavy glass stopper of the bottle in which they were contained. Their smell was putrid, but not fæcal. The flocculent deposit which formed on standing filled one-half of the bulk of the fluid. It consisted of intestinal epithelium in patches, single cells, and cells in all conditions of disintegration, and great numbers of vibriones. The fluid filtered but very slowly, and the filtrate was not clear. Its re-action was strongly alkaline. On dialysis of the alkaline rice-water, the *dialyate* gave an acid re-action, from which, on being neutralized by baryta water, and the fluid evaporated, several matters could be obtained, namely,—(1.) A body crystalline like leucine, and combining with nitric acid ; (2.) An oily substance, which was soluble in water, and with nitric acid gave a peculiar pink re-action ; (3.) Butyric acid, combined with the added barium ; (4.) Inorganic salts in considerable quantity ; (5.) No urea could be discovered in the rice-water stools.

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* In all of this description *post-mortem* results are unfortunately mixed up with vital phenomena; and it is to be regretted that evidence is so contradictory on a matter of fact so definite as the shedding of epithelium during life. So long as the patient lives and passes the characteristic evacuations, I have never seen them containing shed epithelium. It is only in the *post-mortem* contents of the bowel (small intestine) that cylindrical epithelium is to be found—the result, no doubt, of maceration. It is alike found in the stomach, urinary, and gall bladder. Denudation of the intestinal villi, or desquamation of the epithelium, is no essential lesion of cholera. Boehm's statement seems to have been adopted as one of authority, without further question; and while competent observers have agreed with him (*e. g.*, Beale) on the one hand, no less competent observers have not been able to confirm it on the other (*e. g.*, Parkes, Gairdner, Lauder Lindsay). The observations at the London Hospital (*Report*, vol. iii.) and those of Dr. Bruberger of Berlin, who examined the stools of 540 cases, confirm the statements of Parkes, Gairdner, and Lindsay (*Virch. Arch.*, 1847, p. 361, quoted by Parkes in *Army Med. Report* for 1865).

Volatile acids, butyric and acetic, were obtained also from the rice-water stools and intestinal contents, the latter apparently prevailing in quantity. They were combined with ammonia in the original fluid. The rice-water evacuations, therefore, contain the following ingredients:—Vibriones, cells from the surface of the intestine, granular debris of cells, mucine, modified hemochrome, albumen, albuminous body giving rose-pink re-action, butyric acid, acetic acid, ammonia, leucine, inorganic salts. Nearly the same results were obtained by Dr. Lauder Lindsay in 1853. The evacuations are in an active state of decomposition, and evolve gas, which at first is composed almost entirely of nitrogen; soon, however, carbonic acid prevails, and ultimately nothing but carbonic acid is evolved. At one period some hydrogen is developed. In 1848 Dr. Parkes examined many cholera stools, and his observations coincided with those of O'Shaughnessy, Vogel, Wittstock, and Andrew Buchanan (of Glasgow). The thin fluid was always alkaline, and contained an abundance of alkaline chlorides, phosphates, and sulphates, and a certain proportion of albumen. The *odour* was always peculiar.

Dr. Thudichum cannot discover any specificity in the above ingredients; but many of them are analogous to the products of ordinary processes of putrefaction. If it is admitted that the cholera evacuations acquire infective powers only after a period of fermentation, it is also easy to understand that the specific infecting power may belong to albumen or mucine at a particular stage of disintegration or chemical cleavage. The next knowledge which it is necessary to acquire is evidently this—namely, the exact period at which the rice-water stools acquire infective

Contracted immobile pupil - Intermittent pulse -

properties, and their chemical composition at that period. The most dangerous period of the choleraic stools is believed to be when they become very ammoniacal. This occurs usually immediately they are passed, but not to any extent for some time; and anything which makes and keeps them acid prevents the ammoniacal change (PARKES).

Urine in Cholera Re-action.—As the complete suppression of the urinary secretion in collapse, lasting for hours or days, is one of the most striking and peculiar features of cholera, so its re-appearance is amongst the earliest and most auspicious signs of beginning recovery. The first secretion mostly contains the evidence of the mechanical obstruction of the minute channels of the kidneys, and of the general death of the epithelia of the urinary passages. It also contains the sign of continued resistance to the blood current through the kidneys in the form of transuded albumen of the blood. And in many cases it carries small quantities of peculiar abnormal ingredients, which may perhaps be products or remnants of processes engendered by the choleraic process in the blood. The quantity is at first very small—urea much diminished.

The Temperature in Cholera, as determined by Dr. Thudichum, falls steadily from normal to 5·4° Fahr. or 7·2° Fahr. below it, and in most cases very rapidly.

The lowest temperature is quickly reached in deepest collapse; and the minimum temperature of all cases observed in the algide stage are below the lower limits of the fluctuation of health. The maximum temperature of the majority of cases observed are below the upper limits of the fluctuation of health.

The lower the temperature, and the longer the duration of the algide stage, the higher and the longer continued is, on the whole, the temperature of the tepid stage, which does not exceed the upper normal, unless the temperature of the algide stage had previously sunk below 95° Fahr. But the temperature may for a short time reach 95° Fahr. or less, and yet the temperature of the tepid stage not rise above the upper normal.

When the maximum temperature of a case of cholera remains throughout below the normal average, the case will probably be fatal. Among the thirty-nine cases observed, all such cases, seven in number, proved fatal.

On the basis of the thermometric observations alone, cholera may be divided into two stages,—the first or algide stage, from the beginning of symptoms to that period where temperature reaches again the normal limits or average; and the second or tepid stage, in which temperature either remains within the normal limits or rises more or less above them, in some cases even to febrile height, afterwards descending again to normal limits.

But on the basis of all the pathological phenomena and clinical data, the following seven stages of cholera may be distinguished (THUDICHUM):—(1.) *Fœcal diarrhœa;* (2.) *Choleraic diarrhœa and vomiting,* quick sinking of temperature; leading to (3.) *Asphyxia or collapse,* in which lowest temperature is reached; (4.) *Re-action,* which may be defined as the cessation of collapse and the beginning of the re-establishment of the suppressed functions; (5.) *Torpid stage,* or secondary period of algide stage, in which, re-action notwithstanding, temperature remains below the lower normal limits, and then gradually or suddenly rises to the normal average; (6.) *Tepid stage,* in which, during continued re-action, temperature rises to normal or its upper limits, more rarely somewhat above; (7.) The *febrile stage,* only reached in cases where the entire algide stage has been very long, or where there are complications, or secondary lesions arising out of the choleraic process. Re-action does not always terminate the algide stage. For although, from the moment of the beginning of re-action, temperature rises somewhat in most cases, in exquisite cases it does not reach the lower limits of normal fluctuation. The algide stage is evidently continued into the state of re-action, and the tepid stage is the result only of continued re-action. Re-action begins mostly with absorption from the intestinal canal within thirty-six hours from collapse, possibly also with some actual secretions.

The influence of the temperature of the external air upon the temperature of the choleraic process was imperceptible during the observations recorded by Dr. Thudichum, as its range was very equable during the time of observation, the wards being mostly at 66·2° to 68° Fahr.

The lowest temperature observed in any case which recovered was 92·8° Fahr. It is at present uncertain whether there is a minimum temperature below which the body (axilla) cannot be cooled down without fatal results. If there is such a temperature it will probably be about 92·3° Fahr. *A low minimum temperature is at* *present of less significance than a low maximum.* All cases of cholera, the temperature of which ranges persistently below the lower healthy limits, even if no very low minimum temperature was reached, seem to have a fatal prognosis.

"It is all-important to remember," observes Mr. Simon, "that the thermometric observations recorded in this instructive section of Dr. Thudichum's report are exclusively of *external* temperature. In order to a complete understanding of the thermal phenomena of cholera, observations of this kind require to be supplemented by observations of *internal* temperature." And Mr. Simon therefore refers to some such, which have been elsewhere recorded.

In forty cases of collapse treated in the London Hospital in the late epidemic, temperatures were measured, simultaneously in the rectum or vagina and in the axilla, by Mr. F. M. Mackenzie, assistant resident medical officer of the hospital.* Another important set of double observations has been published in Germany by Dr. Güterbock. From these observations Mr. Simon concludes that "the choleraic affections of the bowels is a heat-making or inflammatory" process, on which the development of inflammatory fever, by circulation of blood from the inflamed parts, would as a matter of course attend, were it not that circumstances special to the disease (but accidental) suppress or circumscribe the manifestation. In a typical case of collapse the axillary thermometer shows a temperature perhaps little above 90° Fahr., while a thermometer in the rectum or vagina is marking a temperature high above the normal. With the superficial pulselessness of collapse before one, the suspicion cannot fail to arise that this vast difference of temperature between external and internal parts denotes mainly the failing blood supply of the former; a state which, in so far as it does not equally affect all parts in the aortic circulation, may not improbably "be deemed to depend on the muscular contractility of peripheral arteries." It is not yet determined whether the general temperature of the blood is not febrile.

As regards temperature, the following conclusions were arrived at by Surgeon A. Leith Adams and Assistant-Surgeon F. H. Welch during the epidemic at Malta, of which they have given so admirable a report (*Army Med. Dep. Report,* vol. vi., 1864, p. 341):—

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* Mr. Mackenzie's notes of these observations are published in the third volume of the London Hospital Reports. Besides his observations, others, also made in the East London epidemic, are mentioned more or less fully in the same volume—viz., a few made in the London Hospital by Messrs. M'Carthy and Dove, and some made in the Wapping Cholera Hospital by Dr. Woodman and Mr Heckford.

"1. That a strongly marked, rapid downfall from the average normal temperature, 97°, takes place soon after the setting in of the cholera symptoms, and the extent in proportion to the dose of the poison; the downfall being characterized in the healthy young, and up to middle age, by elevations and depressions, each succeeding one of the latter reaching a lower point than the preceding one; in the aged, weak, or debauched constitution by an uninterrupted sinking of the thermometer. The average fall from normal temperature into collapse was 11°, the extremes 7° and 15° Fahr.

"2. That the highest temperature at which the general symptoms of collapse became apparent was 90°, the lowest 82°, the average 86° Fahr.

"3. That during the period of collapse the temperature underwent but slight variations in the aged, weak, or debauched; while in the young, and up to middle age, it was characterized by undulations.

"4. That the stage of complete collapse is not marked by any characteristic unvarying point of temperature. It would seem that an excessive dose of the poison is accompanied by a corresponding loss of heat; but when the vital stamina is deteriorated by drunken habits or delicacy of constitution, either the general symptoms of collapse are present when the thermometer makes no great fall, or an excessive lowness is reached with no corresponding general indications—*e. g.*, Cases 1, 2, 6, and 13 [in their Report]; while, on the other hand, a hardy well-used constitution does not betray signs of failing until the respiratory function is much interfered with. The lowest point reached during life was 73°.

"5. That a general brightening up of the patient, unaccompanied by any change of temperature, often preceded the final downfall, and was exceedingly deceptive until appreciated rightly.

"6. That the general signs of re-action were preceded by a marked elevation of the temperature, and when convalescence ensued, this re-action was characterized by fluctuations tending towards reinstation of normal temperature. The average rise from complete collapse into full re-action was 6°, the extremes 8° and 4°.

"7. That when death ensued, whether preceded by re-action or not, the fall of the thermometer was most marked and rapid.

"8. That after death a rise of temperature ensued in the cases of great severity and quickness of course; but when the disease was prolonged, the patient falling into that senseless condition well expressed as "death in life," the contrary was the rule.

"9. The readings of the hands and epigastrium followed the breath's variations, though not always in the same ratio. As will be seen, the epigastrium especially showed a great tardiness in assimilating itself to the others, and was very tenacious of its heat.

"Thus, the thermometer indicated that in the aged and delicate the vital powers gave in to the poison, step by step, commensurate with the dose; collapse reached, a comparative quietness ensued, followed by the system asserting its superiority, or succumbing rapidly. The course from the onset to the termination was gradual, with no marked deviations. Not so, however, with the young and healthy. Although the system was compelled to give way to the attacks of the virus, it was not without a struggle; the collapse was marked by constant attempts at re-action, and this having once set in, the vital powers seemed to overreach themselves in their eagerness to resume their normal condition.

"As helps to prognosis, it may be said that a rapid and marked fall at the onset, a temperature below 86°, a further loss of heat during collapse, a setting in of general symptoms of re-action not preceded by rise of temperature of breath and hands, each and individually indicated badly; but it must be borne in mind that the previous habits of life were great influencing causes, and this more especially when drunkenness was the deteriorating agent. This vice, *per se*, appeared to predispose to the disease; but no words can express its baneful effects as demonstrated by the manner in which its devotees succumbed to the poison, even when in a minor state of intensity."

Predisposing Causes of Cholera.—The influence of these is chiefly apparent in the age and sex, food, fatigue, filth, misery, and intemperance of the people.

Both sexes, and all ages, including new-born children, are liable to the disease. Dr. Farr's results show that males suffered more than females at all ages under twenty-five years, but between twenty-five and forty-five the females suffered more than the males. The deaths from cholera in Paris were estimated at 18,402 in 1832; and it was remarked that the mortality was least from six years to twenty, greater from thirty to forty, and greatest of all in old age. The influence of *sex* in predisposing to cholera can hardly be said to be determined; for in Calcutta, of the native inhabitants attacked with cholera, the males were to the females as four to one, while in Bombay the proportion was as seven to twenty-five. In Canada the soldiers' wives were observed to suffer nearly in an equal proportion with their husbands; and this was the case among the civil inhabitants of Gibraltar.

In all countries the *lower classes* have always suffered in a much greater proportion than the upper classes. In Calcutta the disease ran a wide career of destruction in the native town, while the "City of Palaces," inhabited by the English, was much less affected in proportion to their numbers; and the same disproportion has been observed in Bombay. In general, it has been observed, among the native inhabitants of India, that the Brahmin and Banian merchant suffered less than the Ryot or farmer, while the poor outcast Pariah suffered the most of all. In every town in Europe it has been observed that the lower classes, and especially those resident on the banks of rivers, have suffered infinitely more than the upper classes.

In military life it has been believed that the Sepoy suffered more than the European soldier living in India. This, perhaps, is true in some instances; but the returns of the Madras army show this not to have been the fact in that Presidency. There the European soldiers attacked appear to have been as one to three, while of the Sepoy force it was only one in four and a half. In the Indian army, also, it appears to have been universally observed that the officer suffered in a less proportion than the soldier, the cavalry than the infantry, and the infantry less than the hard-labouring ill-fed camp-follower.* The troops on march likewise universally suffered more than the troops in quarters; and this influence of long marches appears to indicate something more powerful than mere fatigue in bringing about the disease. Dr. Balfour has proved that of the native soldiers of the Madras army thirty-two died of cholera in cantonment, and eighty-six when marching, to an average of 10,000 strength; the number attacked being respectively 85 and 200 in 10,000. Dr. Lorimer's reports show that the men were more frequently attacked on long than on short marches, the men (as Dr. Farr observes) being longer exposed to the causes of disease. These causes are those which are incidental to the life of a soldier on the march, such as lying by the banks of rivers, on low marshes, jungly grounds, sleeping on the ground, and encamping amongst the filth of encampments recently occupied, but abandoned—of which indiscretion there were many melancholy examples during the war with Russia in 1854; for example, the occupation of the evacuated camping ground at Aladyn in Bulgaria, and that on the heights above Alma, previously occupied by the Russians, the consequences of which were so fatal to the first and fourth divisions of our army.

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* The Madras Sepoy, of whom alone Dr. Balfour wrote, invariably carries his family with him. At the end of a long march he puts off his accoutrements, and hastens back, without tasting food, to assist his family out of the difficulties incident to a country in which the roads are often mere tracks. He thus often performs nearly double the route march, and finally encamps on ground which for years has been used for the purpose, and is saturated with the excretion of former sufferers from the disease. Moreover, for a long time the authorities in Southern India were most reckless in sending regiment after regiment in one another's footsteps, through districts known to be infected; and as they all occupied the same encamping ground, the last regiments pitched in places saturated with cholera evacuations, and surrounded by the half-buried remains of the dead. These facts to some extent explain the effects of marching on Sepoys (W. C. MACLEAN).

The effects of a poor diet in predisposing to cholera will perhaps be better understood by stating that the European suffers less than the Mohammedan, and the Mohammedan, who is better fed and better clothed, than the Hindoo, except during their rigid fasts, when the Mohammedans suffer in a much larger ratio. During the epidemic of 1848 and 1849, in Edinburgh, Dr. William Robertson of that city found that anæmic persons were those most predisposed to cholera.

Ramadan

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Prognosis.—The mortality from cholera in all countries is very great. Taking the whole number attacked, it is said that the number of deaths in Astrakan were as one to three; in that of Mishni Novogorod as one to two; in Moscow and Kasan as three to five; and in Penza, in the country of the Don Cossacks, as two to three. In the summer of 1831 the mortality at Riga, St. Petersburg, Mittau, Limburg, and Brody, according to the *Berlin Gazette*, was about one-half, while at Dantzig, Elbing, and Posen it was about two-thirds of the whole number attacked. The period of the epidemic, however, greatly influenced the mortality; for, on the first onset, nine-tenths of all those attacked perished, then seven-eighths; and the proportion of deaths forms a gradually decreasing series of five-sixths, three-fourths, one-half, one-third, till, towards the close, a large proportion of those attacked recovered. The uniformity of this law in every country affected with cholera, whether Europe, America, India, or China, is extremely remarkable.

The chances of recovery are much diminished in young children

Med Times & Gazette Dec 11/69 "There is a genl agreement among Indian Practitioners with regard to the following prop[illegible] … Ch is result of a spc poison so that however bad the sanitary condn of a place ch cannot occur without spc poison — It is believed that it may enter system by lungs, stomach especially by contd water — The poison is elimd through aly canal the discharges contg spc poison of the disease —

and in the aged; the age of greatest number of recoveries being from fifteen to twenty. The feeble in constitution, the anæmic, the sick, and the convalescent, were in all cases the surest victims of cholera. But, whatever the age of the patient, Gendrin states he lost every case which became pulseless.

Treatment.—There are few diseases for the cure of which so many different remedies and modes of treatment have been employed as in cholera, and unfortunately without our discovering an antidote to the poison. In Moscow, it is said that the mortality was not greater among those destitute of medical aid than among those who had every care and attention shown them. It may be fairly inferred, therefore, that in the severer forms of the disease the action of this poison is so potent as to render the constitution insensible to the influence of our most powerful remedial agents. When, however, the disease is mild, or on the decline, much may be done, by obviating symptoms, to promote the recovery of the patient.

The remedies that have been mostly employed in cholera are bleeding, opium, astringents, and stimulants, either separately or conjointly. With respect to bleeding, it may be stated, that there are two periods at which its use has been advocated. These are,—(1.) At an early period, to diminish the quantity of black blood in very robust individuals, which would oppress the system at the more advanced stages of the disease. But even when performed early it will not prevent collapse: it is believed, however, to increase the chances of recovery from collapse. It is a highly dangerous remedy when attempted after the pulse has begun to sink, as it then induces an immediate and fatal collapse. (2.) Blood-letting has been advocated at a later period, to lessen the over-excitement of the central circulation, to moderate the violent action of the heart, and to diminish the quantity of black inarterializable blood coming from the more remote vessels. Most benefit is derived in this stage from opening a vein in the foot, or applying as many leeches to the foot as will be sufficient for the end in view (Dr. Andrew Buchanan).

On the appearance of cholera in Europe, opium was administered indiscriminately in the doses recommended by the Indian practitioners, to the greater part even of an ounce of laudanum; but it was soon seen that, in the cold stage, it was inefficient in controlling the vomiting or purging, that it did not allay the spasms, and, moreover, hardly produced any narcotic effect. The action of the accumulated doses of opium, though suspended during the cold stage, was often fully developed in the cases that lived to the period of re-action, and occasioned so much affection of the head, inducing fatal narcotism, or, at the least, interfering with the functions of the kidneys, and so leading directly to uræmic poisoning, that most practitioners either abandoned its use, or limited it to a mere fractional dose of that usually given in India—namely, from *three* to *twelve* minims of the tincture of opium, or half a grain to a grain of solid opium every four or six hours.

In considering the treatment of cholera there are three periods to be provided for,—(1.) The period of diarrhœa which so frequently precedes cholera; (2.) The algide period, or collapse; and, (3.) Period of re-action.

(1.) *The Period of Diarrhœa.*—To check or arrest the diarrhœa is the practical result aimed at by a variety of formula. Those in which opium is the main remedy have acquired the most amount of confidence.

The management of a case embraces the following points,—(1.) The horizontal position of the body; (2.) The administration of opium, with or without cordial stimulants; (3.) The induction of perspiration.

The necessity for the horizontal posture of the patient is, that it aids the efforts of the circulative powers, which tend to weakness.

With regard to opium, its dose must be regulated by (1.) The extent of the nervous prostration; (2.) The rapidity of the dejections; (3.) The extent of vascular depletion. In the cases which present these phenomena in the extreme a much larger dose of opium is required to be given at one time than in the cases less urgent at the outset.

The following formula for pills, each containing a grain of opium, with stimulants, is well known as an anti-spasmodic pill in the early stage of bowel relaxation:—

℞. Pulv. Opii, gr. xii.; Camphor, gr. xxx.; Pulv. Capsici, gr. ix.; Spt. vinc. rect., q. s.; Conserv. Rosar, q. s.; Misce et divide in pil. xii.

Moderate doses of opium or morphine, either alone or combined with stimulants, as the *pulvis cretæ aromaticus cum opio,* were

℞ Pulv. Aromat gr ix
Tinct Catechu ʒss
Tinct Opii ♏ xl

often sufficient to check diarrhœa. The following (*cholera mixture,* as it was called) was proposed by the Board of Health during the prevalence of cholera, and was no doubt useful in many cases of diarrhœa:—

℞. Pulveris Aromat., ʒiii.; Tinct. Catechu, *f*ʒx.; Tinct. Cardam. Comp., *f*ʒvi.; Tinct. Opii, ʒi.; Mist. Cretæ, *preparat.* ad *f*℥xx. Of this mixture the dose is one ounce.

Bulky doses of remedies are, however, very obviously objectionable; and the usual remedies known as "astringents" (compared with each other, or with opium) have no decided influence for good. "Astringents," as such, have merely a negative effect.

The extensive experience of my friend, Dr. Fergus, of Glasgow, in whose practice I was privileged to assist during the epidemic of 1849, led him to the conclusion, which I believe to be true, that "there is a first stage at which cholera is curable and preventible"—namely, laxity of the bowels previous to vomiting, spasms, or uneasiness of any kind. The relaxations of the bowels may not even amount to diarrhœa; and may be to the extent of only two or three stools a day, where one only was usual. Such relaxation was generally thought of no moment, being attended with no pain; on the contrary, the evacuations often gave a feeling of relief. This is the only stage at which NB opium is to be given, and that in a full dose. At this stage, in combination with a stimulant, it is often of the highest value. It is *only* to be given "*if the evacuations are still bilious, the pulse fair, and the skin warm.*" When vomiting, purging, and cramps set in, it is too late for opium—its administration then is absolutely poisonous.

When medical men have charge of large numbers of people, as in the army, navy, prisons, workhouses, asylums, hospitals, and the like, it is incumbent on them to make frequent inspections of those under their care, and to seek out any cases of such incipient diarrhœa. Responsible officers should be made to take notice of those who go more than once a day to the water-closets at times when a cholera epidemic influence prevails. "In military practice," as Dr. Maclean justly observes (MS. notes to the author), "frequent inspection of the men is of cardinal importance. Every man in a regiment should be seen at least three times a day by some medical officer, who should also visit the various guards.

By walking down the ranks at roll-call, and picking out the men who show the earliest symptoms, cases are thus caught in the stage of premonitory diarrhœa and saved."

The following rules were drawn up by Dr. Fergus for the management of large numbers of men, in the factories and offices of Glasgow, over which he had charge when cholera was epidemic:—

"1. Do not be afraid of cholera, or make it the topic of conversation. Fear and all the depressing passions are injurious.

"2. Do not take brandy; it is not a preventative; and it does harm by disordering the action of the stomach and bowels.

"3. Do not make any change in your usual diet, if it is simple and of easy digestion; take it moderately, and at regular intervals, as long fasting is injurious; and carefully avoid excess in any intoxicating beverage.

"4. Take no excessive fatigue; if overheated, beware of any sudden chill, and see that the skin is kept comfortably warm. If the disease appears in winter, much benefit may be derived from wearing a flannel belt round the body, covering the stomach and bowels.

"5. As soon as cholera appears in a town, a bottle of solution of morphia or laudanum (and a graduated measure) should be kept in every house, place of business, factory, or wherever, in fact, there are a number of people gathered together. Persons travelling should always have it with them, or easy of access. During the existence of the epidemic, one person in each factory, &c., should take the charge of the health of the inmates, and should act as 'house physician,' warning all under his or her care to attend to the slightest relaxation of the bowels. He should remind them that the less pain the more danger, and therefore the more need of immediate and energetic action. He should, if possible, ask every individual as to the state of his bowels two or three times a day.

"6. Should the slightest diarrhœa occur, the individual so attacked should at once receive forty minims of solution of morphia or laudanum.* If from home or at business, he should be at once conveyed home in a cab, put to bed, and kept warm. If chilled, warm water bottles may be put to the feet. If the first dose has not checked the looseness, the patient should take a second, and then have a flannel cloth thoroughly dipped in turpentine, placed all over the stomach and bowels for from forty minutes to an hour, or a large, soft, warm poultice of lintseed meal and mustard for one or two hours. If the second dose has not effectually checked the diarrhœa, and medical assistance has not arrived, a third dose may be taken.

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* If a measure is not at hand, a small tea-spoonful. Of course this dose is for adults. Below that age the doses should be a drop for each year till twelve or fifteen, and after fifteen a drop and a half for each year, up to forty minims, or a small tea-spoonful. More portable than laudanum, and of equal efficacy, would be pills composed of a grain and a half of opium and a grain of cayenne pepper in each pill, three of which may be taken with safety, till medical assistance arrives.

"7. The patient must remain in bed two or three days after the diarrhœa is checked. I *insist strongly on this*, for the patient often feels so well that it is difficult to get him to attend to it.

"8. To relieve the thirst, a piece of ice may be given, or a mouthful of iced water, or soda water, but in no case must more fluid be taken at a time, and all food should be abstained from till from fifteen to eighteen hours after the opiate has been administered. *Then*, and for two or three days, the diet should consist of such food as rice, sago, arrow-root, Indian corn flour, tea and toast, &c.; about the third day beef-tea or chicken-soup might be taken.

"9. These rules are for the *first stage, and for it only—i. e., the diarrhœa.* If a person has neglected the first warning, and is in the second stage—*i. e.*, has cramps, vomiting, and stools like rice water, without smell—you should, till medical assistance arrives, place the patient in bed surrounded with bottles of hot water, and give him a little ice, and mouthfuls of soda and water. If the cramps are severe, you must rub the limbs with turpentine, or chloroform and oil" (*Glasgow Med. Journal*, 1866).

But there are certain cases in which, although the diarrhœa may be altogether checked by such remedies, yet the disease is not cured. Symptoms characteristic of the *algide* stage and collapse supervene. These are the cases which give support to that method of treatment which has for its object elimination by the promotion of purging and of vomiting—excretion of the poison by the alimentary canal. In support also of this method of treatment, its advocates lay stress upon the fact that those are the worst cases in which the diarrhœa is the least; and that those cases are the most hopeful in which diarrhœa and vomiting are the most severe.

Dr. Johnson's treatment by castor oil has for its object the elimination of a poison; and it may be said of it, at the outset, that it is neither more nor less successful than other remedies of its class. It, as well as purely astringent mixtures, excite such loathing in most cases that they cannot be persisted in.

Dr. G. Johnson agrees with the rule that "diarrhœa during an epidemic season ought not to be neglected even for an hour." He regards such diarrhœa as an indication of the presence of

Dr Johnson on [illegible] [illegible] [illegible] the only way in which opium can be safely & usefully employed in the early stage of cholera is in small doses, combined with a laxative, or as a soothing agent after the expulsion of the morbid secretions—

offending material in the alimentary canal—*e.g.*, (1.) Unwholesome, undigested food; or, (2.) A large and unnatural accumulation of the feculent contents of the bowel; or, (3.) Noxious secretions poured from the blood into the bowels, in consequence of the action of a specific blood poison: to this latter Dr. Johnson believes *choleraic diarrhœa* to belong.

Therefore, he lays down the following rule,—"Not to attempt by opiates, or by other directly repressive means, to arrest a diarrhœa while there is reason to believe that the bowel contains a considerable amount of morbid and offensive material; for such must come forth before diarrhœa can permanently cease. Purging he considers the natural way of getting rid of the irritant cause; and the safest purgative he believes to be castor oil. So far as meeting the conditions of examples (1.) and (2.) as above, the treatment cannot be improved upon; but that it is the best possible treatment to meet the preliminary diarrhœa or relaxation of the bowels in cholera cannot be regarded as established, nor warranted by what we know of the pathology of the disease as set forth in the text.

Opium is the remedy which, by actual experience, seems most worthy of reliance; *but only at the commencement of laxity, or relaxation of the bowels*, in seasons when cholera is epidemic. NB

On the treatment based upon conflicting theories as to the nature of the disease Dr. Fergus makes the following remarks:—

"The influence of the theories of Dr. Johnson and others is to be seen in the instructions recently issued by the Board of Supervision in Scotland—very excellent as to the sanitary part, but in the medical portion (like most things issued by a committee) an evident compromise. It is a compromise, I believe, between the facts and a theory. . . . We are told, under the fourth section, to take castor oil or rhubarb and soda for looseness of the bowels, and afterwards the astringent mixture or pills—the former being intended as *eliminators* to promote the diarrhœa, the latter to check it. If this advice is followed during an epidemic of cholera, the consequences may be very serious. It is well known that during an epidemic there is a general tendency to relaxation of the bowels, and that they become very susceptible of the smallest dose of even the mildest medicine. Any one who has had much to do with cholera must have frequently met with cases which appeared to be the direct consequence or result of a slight dose of medicine. The risk is that the castor oil and rhubarb would drive most of the cases into the second stage of cholera, and then the use of astringents and opiates at that stage would increase the danger immensely.

"As to the remedies ordered, the quantity of laudanum (viz., five drops per dose) is too small, and there is no necessity for the chalk and catechu. Before the opiate could produce much effect, the stomach would be overloaded with the chalk and catechu, to the extent of inducing vomiting. The pills should be ordered after each discharge from the bowels; but people will find it easier to provide themselves with laudanum than to use complicated mixtures or pills."

In the second or algide stage the object is to promote re-action and to keep it in moderation. If the patient is not seen till profuse discharges—rice-water-like—have taken place, the time for all active treatment has passed, and efforts must be directed solely to restoration and repair.

To promote re-action in cholera and diarrhœa, the following *formula* has met with most universal approval in this country and in India. So highly is it valued, indeed, that it is ordered to be always in store, and in readiness in the "*Medical Field Companion*" of the army when on the march:—*

℞. Ol. Anisi., Ol. Cajeput, Ol. Juniper, ā ā ʒss.; Æther., ℥ss.; Liquor Acid. Halleri, ʒss.;† Tinct. Cinnam., ℥ii.; *misce. The dose of this mixture is ten drops every quarter of an hour in a table-spoonful of water. An opiate may be given with the first and second dose, but should not be continued, for reasons already given.*

Some physicians think calomel should be given in moderate doses, for the purpose of producing a flow of bile into the intestines, as well as of restoring the other suppressed secretions. The indications, however, more generally followed are to treat the case as we should a similar state in typhoid fever (and calomel in small doses has been shown to be of service in connection with the affection of Peyer's glands in that disease), and to moderate the affections of the bowels by mild opiates, by enemata, and by sinapisms to the abdomen; also, to relieve the

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* A memorandum from Savory and Moore, of date 7th June, 1866, shows that the quantities of the *essential oils* in the mixture now issued are increased to ʒiss.

† The *Liquor* or *Elixir Halleri* consists of one part of concentrated *Sulphuric Acid* to three parts of *Rectified Spirit.* It is commonly employed in Germany in the treatment of typhus and allied diseases, in doses of five to twenty drops in solution (MURCHISON, l. c., p. 266).

Dr Murray refers to one outbreak in wh after an
unmistakably free use of stimulants, the mortality
was 92 per cent –

head by leeches and cold lotions, and subsequently, as the tongue becomes brown, to support the patient with wine, sago, strong broths, and a generally cordial treatment.

During the re-action stage Dr. Andrew Clark, of the London Hospital, employed, with great success, a powder composed as follows:—

Hyd. c. Cretâ, gr. ii.; Pulv. Ipecac., gr. ss.; Pulv. Doveri, gr. iiss.; night and morning.

The cases most benefited by this remedy were those in which the tongue had become dry and hard, saline, lemonade, and chlorate of potash drinks being freely given. Mustard plasters or blisters to the nape of the neck were believed to be of use by inducing the return of the urinary secretion.

The sick-room should be supplied with fresh air. Liquids should be assiduously applied to every surface capable of absorbing them, and the patient should be suffered to remain as free from officious treatment as possible. Heat applied in the dry form is to be avoided, but cloths moistened with hot water may be applied; or the patient may be wrapped up in warm moist blankets, and hot bottles or bags of heated sand placed around his cold and benumbed body.

After the temperature is restored, the surface should still be kept moist, by sponging from time to time, or by the use of the wet sheet, to moderate re-action.

Urgent thirst is one of the most distressing symptoms in cholera. There is incessant craving for cold water—doubtless instinctive, to correct the inspissated condition of the blood, due to the rapid escape of the *liquor sanguinis.* It was formerly the practice to withhold water—a practice as cruel as it is mischievous. Water in abundance, pure and cold, should be given to the patient, and he should be encouraged to drink it, even should a large portion of it be rejected by the stomach; and when the purging has ceased, some may, with much advantage, be thrown into the bowel from time to time (MACLEAN). NB

Dr. Andrew Buchanan, of Glasgow, recommends the following as a drink generally relished and retained upon the stomach:—"A raw egg beat up with half a pint of milk, and then mingling them with about a pint and a half of water, adding as much salt as will give the whole an agreeable taste." Or whey, milk and water, weak chicken soup, or any similar decoction, may be drunk *ad libitum.* *Enemata* of warm milk, repeated as often as expelled, are of the highest importance, by supplying an absorbable fluid, by mitigating abdominal pains, and diluting acid secretions.

The secretion of urine may be promoted by dry cupping over the loins, by the use of solutions of *chlorate of potash,* and the like. But suppression of this secretion is most to be dreaded where opium has been too freely used in the treatment. In men of intemperate habits we often see, during the stage of re-action, obstinate vomiting of thick, tenacious, green paint-looking matter, probably bile-pigment, acted on by some acid in the stomach or alimentary canal. It is a symptom of evil omen, and often goes on uncontrolled until the patient dies exhausted, and this although all other symptoms may promise a favourable issue. It may last for a week, resisting all remedies, and proving fatal when the urinary secretion has been restored, and all cerebral symptoms have subsided. Alkalies in the effervescing form, free stimulation of the surface, and chloroform in small doses, offer the best hope of relief for such cases. The patient should be nourished more by the bowel than the stomach when vomiting is present.

Ice should be given *ad libitum,* where it can be obtained, not only to dissolve in the mouth, but to swallow in pieces of convenient size (MACLEAN).

A plan, peculiar perhaps to this country, and which was practised to bring about re-action when the inefficiency of medicines was generally admitted, was an injection into the veins of the suffering patient of a solution of half an ounce of *muriate of soda,* and of four scruples of *sesquicarbonate of soda,* in ten pints of water, of a temperature varying from 105° to 120° Fahr. This solution was injected slowly, half an hour being spent in the gradual introduction of the ten pints, and the immediate effects of this treatment were very striking. The good effects were rapid in proportion to the heat of the solution, but a higher temperature than what is stated could not be borne. After the introduction of a few ounces, the pulse, which had ceased to be felt at the wrist, became perceptible, and the heat of the body returned. By the time three or four pints had been injected, the pulse was good, the cramps had ceased, the body, that could not be heated, had become warm, and instead of a cold exudation on the surface, there was a general moisture; the voice, before hoarse and almost extinct, was now natural; the hollowness of the eye, the shrunken state of the features, the leaden hue of the face and body, had disappeared; the expression had become animated, the mind cheerful, the restlessness and uneasy feelings had vanished; the vertigo and noises of the ear, the sense of oppression at the *præcordia,* had given way to comfortable feelings; the thirst, however urgent before the operation, was assuaged, and the secretion of urine restored, though by no means constantly so. But these promising appearances were not lasting; the vomiting continued, the evacuations became even more profuse, showing that the remedy did not touch the root of the evil. Perhaps, if Hallier's observations are correct, it supplied a pabulum for the fostering and development of the mischief. The patient soon relapsed into his former state, from which he might again be roused by a repetition of the injection; but the amendment was transient, and the fatal period not long deferred. Of 156 patients thus treated at Drummond Street Hospital, Edinburgh, under the direction of Dr. Mackintosh, only twenty-five recovered,—a lamentably small proportion, and, small as it is, it seems doubtful if the recoveries were final or complete (Mackintosh, *Principles of Pathology,* p. 365).

Stimulants tend to inflame the stomach, and are of no use in exciting the heart to any salutary action. Employed as in typhus, they are worse than useless.

All violent remedies in this disease, as in others, are greatly to be deprecated. Strychnia, prussic acid, tobacco, galvanism, boiling water, the actual cautery, or firing the spine, or bags of ice to the spine, or injections of spirits, are proven by trials to be of no use, nor can their recommendation be supported except upon baseless theories, having no rational relation to the pathology of the disease. Large doses of calomel or of lead are alike detrimental. Nature effects a cure by slowly restoring the constitution of the liquids of the body.

To generalize on the subject of remedies in cholera, the broadest conclusion seems to be, that remedies with an acid rather than an alkaline or neutral re-action have been most beneficial.

Prevention of Cholera.—The following summary by the highest authority on this subject, Dr. Parkes, will best conclude this account of cholera. The importance of the topics noticed may justify, it is hoped, the amount of space which the subject has taken up:—

"For the first time in the history of cholera a new system of prevention has been brought largely into play in Europe—viz., the addition to the discharges of a presumed disinfecting substance. This plan, of course, is based on the belief that the principal (perhaps the only) mode of spread is by means of the putrefying evacuations; and the results obtained by it gives certainly some strong evidence in favour of this opinion.

"In this country the difficulty has been to make the public (and, in some cases, even the medical men) sensible of the importance of this plan, and of the necessity of giving it a complete trial. In some cases in which it has really been fairly tested, it appears to have arrested the spread of the disease, as at Bristol, and Dr. Budd's paper in the *British Medical Journal*, April 13, 1867, gives good evidence on this point. In Southampton also, I believe, the spread was limited in this way, though it was not arrested so perfectly as at Bristol. In London and several provincial towns the method was also tried more or less fully.

"In Germany, owing to the influence of Pettenkofer, the disinfecting plan was also brought into play, and the system followed has been described by that chemist.*

"Without analyzing all the evidence, I proceed to give the most important practical rules.

"The dangerous period of the choleraic stools is supposed to be when they become very ammoniacal. This occurs sometimes immediately they are passed, but usually not to any extent for some time. It is thought (but of course exact scientific proof is not readily attainable) that anything which makes and keeps them acid prevents the changes which cause the poison.

"The three principal means of doing this are the use of *carbolic acid*, and *sulphate of iron* (with or without *permanganate of potassium*), and the *salts of zinc*. Each has its advantages, and all may be used. The *carbolic acid*, from its liquid form and from its volatility, is excellently adapted to purify air, and to be used when surfaces are to be washed. It is also useful for sewers and closets. The *sulphate of iron* in substance and strong solution is better adapted for being put in the utensils in a room, as it has no smell, but it may be equally used for sewers and for watering streets. The *sulphate of zinc* (for the *chloride* is too dear) is better adapted for being put on linen or on floors, as it does not ironmould the linen like the *sulphate of iron*.

"The *carbolic acid* has not been used much in Germany, as it is still too dear; but Pettenkofer makes an observation of importance—viz., that when added to *sulphate of iron* the mixture seems to have more power of preventing ammoniacal development than either substance separately.

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* "Cholera Regulativ, von H. Griesinger, M. Pettenkofer, and C. A. Wunderlich, *Zeitschrift, für, Biologie*, Band II., p. 435."

If so, it might be desirable, as a matter of practice, to use the two together as much as possible. The salts of zinc (*sulphate* or *chloride*) may be also used, but are perhaps not so good, and in some forms are dearer than the iron salts. *Chloride of lime* does not prevent the ammoniacal change, and appears altogether less useful.

"The quantity in which these substances must be used is as follows:—For each healthy person, daily, about three-quarters of an ounce of *sulphate of iron*, or one drachm of strong (but impure) *carbolic acid*, are sufficient. This amount will entirely prevent any decomposition of the fæces for several days. In a town, therefore, where sewers are used, the above amount of *sulphate of iron*, or *carbolic acid*, multiplied by the number of persons, should go into the sewers daily, and, if possible, should be passed in from the houses, so as to act on the house drains as well as on the main sewers. If the place is not sewered, then the disinfectants should be added to the cess-pools, middens, latrines, or whatever plans may be in use. If both *sulphate of iron* and *carbolic acid* are used, which is to be recommended, half the quantity of each should be employed. The iron should be dissolved in a good deal of water.

"Dr. Kühne, who has made a great number of experiments on the action of various agents on fermenting substances, does not reckon the value of the *sulphate of iron* or of *carbolic acid* so highly as other observers. He states that neither arrest the various fermentations. Such an arrest is, however, attained with strong alkalis and strong acids; with *chlorine, chloride of lime, bromine, permanganate of potassium* and *sodium*, and *permanganic acid*. On the hypothesis, therefore (for it is nothing more), that the dangerous condition of the cholera discharges is one of "fermentation," he recommends any one of these substances rather than *carbolic acid*, and for common use prefers *permanganate of sodium*, to which (as a concession to Pettenkofer) he mixes some *sulphate of iron*. The proportions are two parts of *permanganate of sodium* (solution ?), forty-five parts of *acid sulphate of iron*, and fifty-three parts of water in one hundred parts.

"It must be remembered, however, that such points as these must be decided by actual experience, and that arguments derived from the action of these substances on common ferments are not very satisfactory as regards the prevention of cholera.

"In Southampton, in 1866, carbolic acid was chiefly used; and the average amount was about twenty gallons daily for a town of 50,000 people: it certainly appeared useful.

"If an aerial disinfection is needed, *sulphurous acid* (obtained by burning sulphur) is perhaps the best. *Nitrous acid fumes* are certainly very powerful; and one or other of these substances should be used for half an hour daily in all privies or latrines.

"For washing clothes the iron salts are not applicable, as they stain linen. *Carbolic acid* gives a disagreeable smell. Either a watery solution of *sulphurous acid* or a solution of zinc salts should therefore be used. Baking the clothes, at a temperature of 250°, or boiling, should be used.

"In hospital wards, dead-houses, &c., it is a good plan to sprinkle saw-dust on the floors, and to moisten it with weak *carbolic acid* (one part of crude acid in sixty or eighty of water).

"These measures should be commenced when cholera is apprehended. Every privy and sewer should have twice daily the mixed *carbolic acid* and *sulphate of iron* solution. If cholera is introduced, the amount should be doubled in the privies of all the adjacent houses, while the closet of the affected house should never act without a portion of the disinfecting liquid being placed in it. If the disease breaks out, a plan recommended by Dr. Budd is worthy of imitation—viz., to place a layer of *carbolic acid* powder (carbolic acid and lime) in the bed, under the breech of the patient.

"The disinfection in this way of the closets and privies of hotels, railways, and workshops, should be commenced very early.

"As a precaution against cholera, quarantines have only answered when they are absolute, and an absolute quarantine is not possible for a commercial people. The reason of the failure of partial quarantines is the fact that the diarrhœal stools will propagate the disease, and that the period of incubation, though usually short, may be prolonged even to twenty or twenty-five days. Restriction on movement must therefore be used or not according to circumstances, but in all cases persons coming from infected districts ought to take measures for disinfecting their evacuations in the above manner."

The inquiries made through the Epidemiological Society show that special hospitals, or special wards in hospitals, ought to be devoted (with a separate and special staff of attendants for day and night duty, or more frequent periods of relief) entirely to the management of cholera patients.

For further details, see management of epidemics generally, page 226 *ante*.

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CHAPTER VI.

PATHOLOGY OF THE ENTHETIC ORDER OF ZYMOTIC DISEASES.

THE diseases which belong to this order have the common property of becoming developed in the system after the introduction by inoculation or implantation of specific poisons. The sources of such poisons are more distinctly traceable than those which produce the miasmatic diseases; in other words, the substance or material which contains the *poisonous principle* can be obtained in most instances, although the *principle* itself has not been isolated by any chemical process. The poisons which produce the diseases of this order may be introduced through thin or abraded cutaneous surfaces, or through mucous membranes by the process of absorption, although, in most instances, it is believed that some solution of continuity exists. Others are directly introduced by weapons which inflict a wound or abrasion, and which at the same time introduce the poison. "Poisoned wounds" thus indicate or name a disease defined as follows:—"*Wounds inoculated with foreign matter, producing general symptoms, or propagating inflammation to other parts of the body.*" In all instances the poison is received into the system by the processes of absorption, and the individual thus becomes inoculated. Thus, germs of a *specific* kind become directly implanted, and by a zymotic-like process become developed and increased in quantity or virulence till symptoms and effects are produced characteristic of the specific affections; and hence the name given to this order of diseases. No one has better illustrated the pathology of these diseases than Mr. Paget, from whose lectures *On Surgical Pathology* the following statement is given:—

When a morbid poison is inoculated, it produces a specific effect, both on the tissue at the place of insertion and on the blood, as soon as the poison, or any part of it, is absorbed; in other words, it produces both a constitutional and a local change; and in both these effects its history must be traced. The specific local change is best seen in the implanting of certain animal poisons, such as those of venomous serpents and insects, and the results most rapidly follow the implantation of such poisons. The consequences of the insertion of such poisons are peculiar, and constant in their peculiarities. The bite of a bug, for example, is followed, within less than a minute, by itching in the bitten part, and very soon a wheal, or circumscribed pale swelling, with a nearly level surface and a circumscribed border, gradually rises and extends in the skin. The swelling is produced by œdema of a small portion of the cutis at and round the bite. As the itching subsides, the pale swelling becomes less defined, and the more general vascular swelling of the surrounding and adjacent tissues gradually encroaches on the primary swelling at the bitten spot. In about twenty-four hours a papule or some form of secondary inflammation appears, with renewed itching at the site of the puncture. This, too, in the case of the bug-bite, gradually subsides. The primary swelling here described illustrates the immediate effects of the morbid poison on the tissue at and round the seat of inoculation, and within the area of such a swelling the tissues are, by the direct contact or influence of the venom, altered in their nutritive relation to the blood. Such specific alterations of the tissues at the seat of inoculation occurs with the syphilitic, the vaccine, and such-like virus; but the direct influence is most rapidly shown in the effects of the bites of the viper, the rattlesnake, and the *cobra di capella*. In such cases sloughing of the areolar tissue is established immediately after the bite. The poison seems to operate at once on the tissue, neither in the direction of the nerves, nor of the absorbents, nor of the blood-vessels; but the slough forms at the puncture, as if the venom had completely and at once killed the tissue (Brodie, Paget).

A secondary inflammation soon appears at the bitten or punctured part; and the occurrence of this new inflammation may be ascribed, in some measure, to an influence exercised by the virus on the blood; and it proves that the part does not return to health, although the first effects of the inoculation may subside. It proves that some material of the virus remains, or that the effects it has already produced upon the tissues at the injured part alter their relations to the blood, and render the part prone to specific disease. These specific effects upon the part may remain locally quiescent for a considerable length of time—during all that period of latency or incubation which intervenes between the inoculation and the appearance of the specific disease. But during all this interval—during all this period of incubation—the tissues at the site of inoculation are constantly changing; and the virus itself, like all organic matter, is probably in constant process of transformation till the *zymosis* is complete, and the specific disease is fully developed and expressed by various constitutional phenomena.

Dr. George B. Halford, Professor of Anatomy in the University of Melbourne, has recently (*Brit. Med. Journal*, July 20, 1867) given an interesting account of the action of the poison of the *cobra* upon the blood.

> "When a person is mortally bitten by the *cobra di capella*, molecules of living 'germinal' matter are thrown into the blood, and speedily grow into cells, and as rapidly multiply, so that in a few hours millions upon millions are produced at the expense . . . of the oxygen absorbed into the blood during respiration; hence the gradual decrease and ultimate extinction of combustion and chemical change in every part of the body, followed by coldness, sleepiness, insensibility, slow breathing, and death.

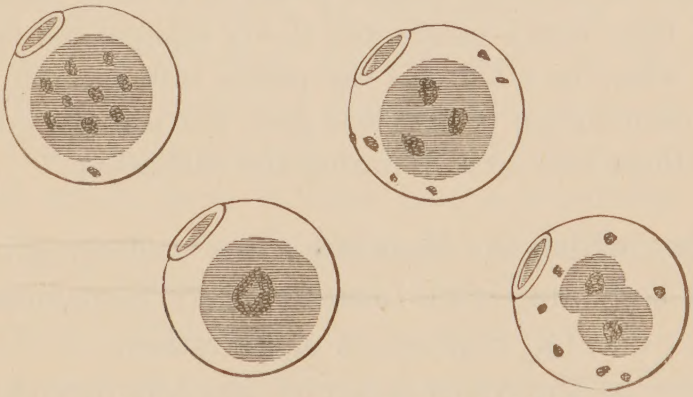

Fig. 2.—Magnifying power × 1050.*

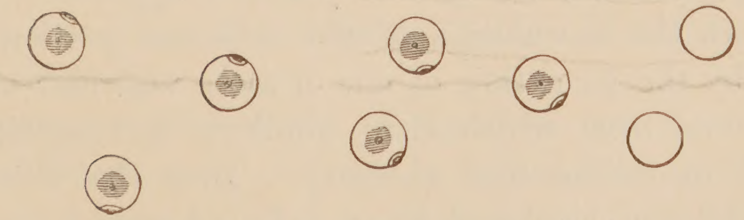

Fig. 3.—Magnifying power × 400.*

The cells which thus render in so short a time the blood unfit to support life, are circular, with a diameter, on the average, of $\frac{1}{1700}$th of an inch. They contain a nearly round nucleus of $\frac{1}{2500}$th of an inch in breadth, which, when further magnified, is seen to contain other still more minute spherules of living 'germinal' matter. In addition to this, the application of magenta reveals a minute coloured spot at some part of the circumference of the cell. This, besides its size, distinguishes it from the white pus or lymph-corpuscle.

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* Figs. 2, 3.—Changes in the blood corpuscles subsequent to the bite of the *cobra di capella*.

"Thus, then, it would seem that, as the vegetable cell requires for its growth inorganic food and the liberation of oxygen, so the animal cell requires for its growth organic food and the absorption of oxygen. Its food is present in the blood, and it meets the oxygen in the lungs; thus the whole blood becomes disorganized, and nothing is found after death but dark fluid blood, the fluidity indicating its loss of fibrine, the dark colour its want of oxygen, which it readily absorbs on exposure after death.

"Let it not be thought that microscopic particles are unable to produce such great and rapid changes. It is well known, and I have frequently timed it with my class, that a tea-spoonful of human saliva will, when shaken with a like quantity of decoction of starch, convert the whole of the latter into sugar in a little less than one minute. If ptyaline, the active principle of saliva, exerts this power at most in a few minutes, then surely the active principle of the secretion of the serpent's poison-gland may exert an infinitely greater power in as many hours.

"It results, then, that a person dies slowly asphyxiated by deprivation of oxygen, in whatever other way the poison may also act, and so far as the ordinary examination of the blood goes, the *post-mortem* appearances are similar to those seen after drowning and suffocation."

The changes which the absorbed virus undergoes in the living and infected body are,—(1.) Increase; (2.) Transformation; (3.) Combination; and (4.) Separation or excretion.

The *increase* of the virus is shown in such inoculable diseases as *vaccinia, glanders, malignant pustule, syphilis.* In all of these diseases the inoculation of the minutest portion of virus is followed by the formation of one or more vesicular structures, containing fluid from which virus, similarly and equally potent, is produced in million-fold quantity. Thus the virus of any contagious disease developed in an infected person may render his exhalations capable of similarly affecting thousands of other people. And it is probably among azotized materials chiefly that morbid poisons, whether of animal origin or of disease, find the means of their increase (CARPENTER, PAGET, SIMON).

The *transformation* of the virus is indicated by the successive phenomena which supervene during the continuous course of a specific disease. For example, syphilis is followed by a series of secondary and tertiary phenomena, which follow, on the whole, a uniform course in a great variety of patients; so that these regular syphilitic phenomena may be attributed to the *transformations* of the morbid poison; while the irregularities of the phenomena may be ascribed to constitutional peculiarities of the patient, either natural or acquired from treatment. Thus there are periods of incubation, of development, of maturity, and of degeneration in the material of the virus; and the various phenomena which constitute the *symptoms* and *prodromata* of the disease correspond to such periods of transformation; while the increasing disturbance of the general health probably implies that the morbid poison is increasing while it is being transformed —that it grows or multiplies with its development.

The *combination* of a morbid poison with some normal material of the blood is indicated by the circumstance, that when the same specific disease, produced by the inoculation of the same matter, affects many persons, the disease set up in each of them may present different peculiar features. The disease may have some peculiar and varied methods of expressing its development in different persons—"*personal peculiarities*," as Mr. Paget calls them, and which he considers due in some measure to the combination of the virus with one or more of those normal materials of the blood which have in each person a peculiar or personal character. By such combinations the following characters of specific diseases may be explained, namely,—(1.) Changes in the disease by transmission from one person to another; (2.) Some varieties of syphilitic sores, and varieties of their consequences in different persons inoculated from the same source; (3.) The change in the forms of secondary syphilis in transmission from parent to offspring.

The *separation* or *excretion* of the virus may be accomplished in many different ways, and may be regarded as the final purpose of the morbid process. It is evident in the inoculable products of some vesicles and pustules.

In all of these *enthetic* diseases the immediate or the ultimate effect of the poison is to induce deterioration of the blood, and at the same time the poison seems to multiply itself, or to increase in power by some mode not quite well understood, and which has been likened to the *zymotic* action which is known to take place in fermentation. The process by which the poison is multiplied, or by which its virulence or strength is increased, varies much as to the time required for its completion.

Some of the more intense and virulent poisons, such as that of the most venomous serpents, produce their deleterious and perhaps fatal effects in as short a time as it takes the blood to complete a circulation. The change in the blood at once commences, and death rapidly follows. This sometimes happens with some forms of the *cadaveric poison,* as that which results from wounds received in the dissection of virulent cases of puerperal fever.

Other poisons do not exert their pernicious influence till after a tardy process of incubation, the time of which is not constant, as in *hydrophobia.*

In a third class of poisons which produce diseases belonging to this order, a double process of the zymotic-like action seems to take place before the full effects which the poison is capable of producing are completed. The syphilitic poison is an example of this. The multiplication of this venereal poison, and its effects upon the system, seem to become developed during the existence of the hardening process which surrounds the *infecting* venereal sore.

This is the first zymotic-like process, and is attended with a local papule, and perhaps an ulcer. From this local sore the system becomes contaminated; and in the blood a second process (of zymosis?) appears to be completed, by which the original poison becomes intensified, its pernicious influence more complete, and its specific secondary and tertiary effects are then fully developed.

Many of the diseases implanted by specific poisons claim the attention rather of the surgeon than the physician, and therefore they may be considered as not properly coming within the scope of this text-book of medicine. But for the sake of the pathological doctrines they illustrate, also because of the importance of their effects upon the system, and in relation to other diseases, some of them will be considered here.

Under the head of "Poisoned Wounds," the following *varieties* may be recognized:—(*a.*) By venomous animals, comprehending snakes, scorpions, and stinging insects; (*b.*) By animals having infectious or communicable disease, comprehending *glanders, farcy, equinia mitis, malignant pustule, hydrophobia, cow-pox;*

(*c.*) By dead animal matter; (*d.*) By morbid secretions; (*e.*) By vegetable substances, comprehending *arrows poisoned by wourali* and subcutaneous injections of vegetable substances; (*f.*) By mineral substances.

CHAPTER VII.

DETAILED DESCRIPTION OF THE ENTHETIC ORDER OF ZYMOTIC DISEASES.

HYDROPHOBIA.

LATIN EQ., *Rabies;* FRENCH EQ., *Hydrophobie;* GERMAN EQ., *Wasserscheu;* ITALIAN EQ., *Idrofobia.*

Definition.—*A disease peculiar to animals of the canine or feline race, the specific poison of which, being implanted by them in man, or in other animals, produces a similar malady. The saliva or secretion issuing from the mouth of the diseased or rabid animal conveys the poison which inoculates rabies, either through a wound or through a thin epidermis without abrasion. The period of incubation of the poison after inoculation varies from four to sixteen weeks, or even longer, before the malady becomes developed. The disease is characterized by severe constriction about the throat, spasmodic action of the diaphragm, and distress at the epigastrium: all of which are aggravated or brought about by attempts to take fluid, or by the least breath or current of air on the surface of the body, which produces, in the first instance, an effect resembling that produced upon stepping into a cold bath. Tenacious and clammy saliva issues from the mouth. Paroxysms of phrensy, or of uncontrollable impulsive violence (rabidity), supervene. The duration of the disease varies from* three *to* six or seven *days, the greater number of cases terminating in death on the second and fourth days from the accession of symptoms. Death is generally sudden, and unexpected at the moment.*

Pathology and Symptoms.—The saliva of the dog or other animal labouring under rabies is either the virus, or contains (as any menstruum would) the poisonous principle which by inoculation produces *hydrophobia* in the human body. The disease is so named, not because there is any dread of water, but because in man the most prominent symptom is an inability to swallow, or to attempt to swallow, any fluid, on account of the extreme spasms which the attempt produces. The experiments of Hartwig have proved that the poison is of a definite character, that it may impregnate various substances, and that it retains its activity for a long period.

Two points in the pathology of *rabies* are peculiar—namely, *first*, that a long period of latency exists in the human subject; and, *second*, that inoculation is not always followed by the development of the specific disease.

With regard to the first of these peculiarities, it is to be noticed that, although in some cases pain has been felt in the cicatrix a considerable time after the accident, and in a few a slight fever or a rapid pulse has been remarked to continue from the receipt of the injury to the outbreak of the malady, still the symptoms of the disease in man seldom show themselves sooner than the *fortieth* day after inoculation, and rarely after two years. A matured zymosis seems essential to the production of the full influence of the poison, and it may be that a double zymosis takes place, as in the case of the venereal virus, first in the part and afterwards in the system (Miller), the result of which is either to multiply the poison or to increase its virulence.

Undoubted instances are, however, on record in which the characteristic symptoms appeared as early as the *twelfth* day (Sidey), and on the *eighth* day (Troilliet), who even quotes instances of their occurrence as early as the day following the injury. The duration of the period of incubation, however, is sometimes of extreme duration. It has been satisfactorily proved to extend over five and a half, six, or even nine months (Bergeron, Brandreth); and there is on record a large body of evidence in favour of the opinion that the incubation stage of hydrophobia may be prolonged not only over a series of months, but also of one year at least. An analysis of sixty authentic observations by Romberg has shown that the shortest interval between the introduction of the poison and the appearance of the disease is fifteen days, the longest from seven to nine months, and that the average period is from four to seven weeks. The inquiries of Drs. Hamilton and Hunter give to the majority of cases a period of incubation from *thirty* to *fifty-nine* days. In the *Transactions of the Vienna Medical Association* a case is recorded of a period of incubation extending over two years (Hassinger); but this is discredited both by the elder and younger Gurlt, of Berlin, whose experience in veterinary pathology has been very extensive. In all such extremely long cases the question may be asked, whether the disease has been actually inoculated at a period so far back, or has there occurred a re-inoculation at some intervening period? It is known that the dog in the early stage of the disease has a disposition to lick the hands, face, or other exposed parts of persons, and especially of those with whom it is familiar; and there are cases on record where the disease has been implanted in this way. Mr. Lawrence mentions the following:—"A lady had a French poodle, of which she was very fond, and which she was in the habit of allowing to lick her face. She had a small pimple on her chin, of which she had rubbed off the top; and, allowing the dog to indulge in his usual caresses, he licked this pimple, of which the surface was exposed. Thus she acquired hydrophobia, of which she died." While this example teaches us that hydrophobia may be implanted without a bite being inflicted, in this almost unconscious manner, it ought to deter us from permitting such indulgences to a dog. The greatest anxiety and misery have frequently been experienced for many months by those who have been thus imprudent, owing to the circumstance of rabies having subsequently appeared in the animal so indulged (Copland). There are instances, however, recorded of very long periods of incubation after a bite, where subsequent inoculation, independent of a bite, could not have taken place. For example, there is a case published by Mr. Hale Thomson in vol. i. of the *Lancet*. The subject of it, a lad aged eighteen, had been twenty-five months in close confinement in prison, and during that time had never been exposed to the bite of any animal. He had been bitten severely by a dog seven years before in the right hip, and the scar still remained. During the whole period he was under observation he was sullen, gloomy, and reserved, and was never known to look the person in the face to whom he spoke. Death occurred after a three days' illness, during which "the most decided symptoms of hydrophobia were manifested." On the 15th of May, 1854, a case was admitted into Guy's Hospital, under the care of Dr. Hughes, in which hydrophobia appeared to have been developed five years after the bite (*Med. Times*, 1854).

Such observations render it extremely probable that the period of incubation of the specific poison of hydrophobia is indefinite; and the circumstances which, in man especially, seem to shorten the duration of this period or prolong it, are in a great measure quite unknown. There are some other circumstances which seem to show that during the long interval of apparent latency the quantity or the virulence of the implanted poison seems to increase, locally at least, if not also more extensively in the system.

First, In some instances there are evidences of a slow and silent change going on in the constitution, indicated by sallow looks, sunken eyes, a pulse somewhat accelerated, more easily excited and weaker, combined with symptoms of general debility (COPLAND).

Second, The observations of Dr. Marochetti, who visited the Ukraine in 1820, and who maintained that in that country characteristic pustules were observed to form beneath the tongue, near the orifices of the submaxillary glands, between the third and ninth day after the infliction of the bite. This observation was confirmed by M. Magistel, at Boulay, in France, in 1822, who noticed that the pustules formed from the *sixth* till the *thirty-second* day. He observed two forms of pustules, a crystalline and an opaque, the latter of which, when opened, left a small ulcerated cavity. They were situated on the sides of the *frœnum linguœ*, and on the lateral parts of the inferior surface of the tongue.

Third, Changes which take place in the cicatrix before the development of characteristic symptoms, indicate that the implanted poison there undergoes some process, the nature of which is as yet not known.

After the local incubation of the poison is complete, its specific action appears to be exercised upon the *medulla oblongata* and the *eighth pair of nerves*, and subsequently lesions of the structures supplied by the branches of the *eighth pair*. The action of the poison appears in the first instance to be made distinctly manifest by the œsophageal branch of the *eighth pair*, producing that derangement of function which gives rise to the characteristic symptom of the disease, or to the extreme difficulty of swallowing, especially of fluids; while the spasmodic catching of the breath, consequent even on touching the lips with any liquid, proves that the recurrent nerve is equally affected. Subsequently the eye and ear become distressed by every ray of light or impulse of sound, and likewise the sense of touch is most painfully excited on the slightest breath of air passing over the surface of the body, all of which distinctly show that the central and spinal nerves must be functionally affected. In a still more advanced stage the suspicion, the irritability, the violence, and generally the outrageous and uncontrollable derangement of mind which often seizes the patient, bringing on epilepsy and convulsions, show that the brain itself is likewise a principal seat of the action of this terrible poison, especially the region of the *medulla oblongata.* The effects of the hydrophobic poison are often so violent in the first instance as to cause the early death of the patient; and the bodies of many persons having been examined who had so died, not a trace of inflammation or other morbid phenomena were discovered. More commonly, however, some structural alterations have been found, limited to slight inflammation of the brain, the spinal cord, or of their membranes, and of the lungs, stomach, or structures supplied by the *eighth pair* of nerves. Still, the brain, the lungs, or the stomach, may be either separately or conjointly affected—phenomena in no degree dissimilar to what have been observed in hooping-cough, where the poison seems to act chiefly on the vagus nerve.

The organic lesions which have been found after death in cases of hydrophobia are as follow :—

When the membranes of the brain have been found diseased, the appearances have been, great congestion, especially of the *plexus choroïdes,* also effusion of serum, sometimes muddy, into the arachnoid cavity, and into the ventricles. In an interesting case recorded by Dr. R. W. Cunningham, of Her Majesty's 4th Bengal Europeans, the layers of the arachnoid were found adherent in many places, especially along both sides of the longitudinal sinus. The adhesions were quite soft and recent, and flakes of coagulated fibrine floated in the fluid. The brain has, in some very few cases, been supposed to be harder or softer than usual, and to have more bloody points than in health. There has been no lesion noticed, however, that could be directly connected with the malady. Changes in the *medulla oblongata* and the *spinal cord* have not yet received sufficient attention. In the case just referred to, related by Dr. Cunningham, there was a reddish spot in the substance of the *pons varolii,* having the appearance of inflammatory softening. On the lower surface of the *medulla oblongata,* at the origin of the *seventh, eighth,* and *ninth pair of nerves,* the membranes were highly vascular, thickened, softened, and matted together; but the substance of the nerves at their exit, and of the *medulla,* seemed normal. There are strong reasons for believing that changes actually exist in these parts which escape the detection of our unaided senses, but which the specific gravity test, combined with microscopic examination, may yet demonstrate. The mucous membrane of the pharynx and œsophagus have been seen either greatly congested or diffusely inflamed, as also that of the stomach, and of the trachea and bronchia. The latter have been found covered with a considerable quantity of frothy mucus, while the pulmonary tissue has shown marks of inflammation, though more commonly only of great congestion. The salivary glands have likewise occasionally been observed increased in size, and vascular. In a case of hydrophobia which I had an opportunity of dissecting at Renfrew, near Glasgow, the most prominent morbid change was visible in the greatly increased vascularity of the lungs, and of the mucous membrane of the back part of the mouth, pharynx, and larynx, as far as the vocal cords. The whole of these parts were covered by a tenacious frothy mucus, tinged with blood. The glands surrounding the papillæ over the back part of the tongue were very much enlarged, not unlike what I have observed in severe cases of cholera. So also were the submucous glands of the pharynx, the epiglottis, and the larynx, even in its cavity, and of those beneath the tongue. Inflammatory appearances in these parts have been observed by Morgagni, Babington, Watt, Portal, Troilliet, Copland, and others.

Symptoms.—The wound inflicted by the bite, whether neglected or dressed, generally heals up kindly, leaving a cicatrix, and for a time the patient usually suffers no other derangement of health than the depression of spirits which his apprehensions are calculated to excite. A few weeks or a few months having elapsed, the latency of the poison terminates, and the disease is formed. The course of the affection is usually divided into three stages, the first stage comprising the symptoms which precede the difficulty of swallowing; the second commences with the difficulty of swallowing, and terminates with the overthrow of the mind; the last stage embraces all the concluding phenomena.

The first stage commences in a few instances by the patient's attention being aroused by a numbness extending towards the sensorium from the injured part (which, if an extremity, may become tremulous); or pain is felt in the cicatrix, sometimes severe and sometimes trifling, and which shoots up the bitten limb, following in general the course of the nerve towards the trunk. It shoots as if towards the heart, but there is no evidence of lymphatic absorption. Pain, however, is by no means constant, and is for the most part absent. In the latter case the first symptom is chilliness, with headache, or a slight attack of fever, and the patient is more excited or depressed than usual. These premonitory warnings last but a few hours, or at most a few days, when the fatal but characteristic symptom, "the difficulty and dread of swallowing"—a symptom which distinguishes this malady from all others—appears, and the hydrophobic stage commences.

The second or hydrophobic stage is ushered in with a great difficulty, if not an utter impossibility, of swallowing any liquid—a symptom which generally comes on suddenly; and such horrible sensations accompany the effort, that whatever afterwards even recalls the idea of a fluid excites violent agitation and aversion. Some patients who have been able to give some account of themselves describe the hydrophobic sensation as a rising of the stomach which obstructs the passage; others as a feeling of suffocation, or a sense of choking, which renders every attempt to pass liquids over the root of the tongue not only impossible, but which excites convulsive action in the muscles of the larynx, pharynx, and abdomen. In this state, says Dr. John Hunter, "the patient finds some relief from running or walking, which shows that the lungs are not yet the seat of any great oppression."

The hydrophobia, or inability to swallow fluids, is shortly accompanied by an increased flow of saliva, termed the "hydrophobic slaver." This secretion, as the disease advances, is not only copious but viscid, so that it adheres to the throat, and causes incessant spitting, and the quantity expectorated may be taken as the measure of the violence of the disease. By some this increased flow of saliva is considered as an effort of the system to eliminate the poison through these excretory glands;

and, therefore, mercury in large doses, to promote salivation, has been recommended to promote elimination in this way, and to reduce the extreme excitability of the nervous system (Ligget).

The aversion to fluids is no sooner established than another series of symptoms of dreadful severity, or a highly exalted state of every corporeal sense, is added. Indeed, it is hardly possible to depict the sufferings of the patient from this cause; for not only does he shrink at the slightest breath that blows over him, but the passage of a fly, the motion of the bed-curtain, or any attempt to touch him, produces indescribable agony, almost amounting to convulsions. Dr. Elliotson states that the effect produced by these causes very much resembles that produced upon stepping into a cold bath. The sense of sight is no less a source of terror than that of touch, for the approach of a candle, the reflection from a mirror or other polished surface, occasions the same distressing effect. The hearing is as strongly affected as the other senses, so that the least noise, and especially that of pouring out fluids, throws him into a fearful paroxysm. An attendant who sat up with a hydrophobic boy made water within his hearing, which threw the sufferer into a most violent agitation. The degree to which this painful state of the senses arrives may be understood when it is stated that Majendie records the case of a deaf and dumb child who heard distinctly in this stage of the disease. The patient, thus incessantly harassed and pained by every circumstance around him, becomes peevish and irritable, and at length sees his family, relations, and strangers, with feelings of dislike and aversion, and sometimes apparently with horror.

(3) The third stage commences by the cerebral functions becoming disturbed, the mind being either filled with dreadful apprehensions, or being so completely overthrown that paroxysms of uncontrollable impulsive violence follow. A rabid impulse overtakes the patient to tear in pieces who and whatever opposes him. This rabid impulse greatly distresses him; and it is often strongest against those to whom he is most attached, although he struggles to suppress it. In this stage horror is strongly depicted on the countenance: every symptom is aggravated, the saliva grows thick and ropy, while the poor sufferer, not daring to make the slightest attempt to swallow, spits it out incessantly, oftentimes with frequent retchings and vomiting. In this state he sometimes turns

black in the face, falling into convulsions, in which he expires; or, exhausted by his great efforts, a sudden calm ensues, and, as if nature gave up the struggle, he dies without a groan.

Remote Cause.—Hydrophobia originates in animals of the canine and feline races, as the dog, the fox, the wolf, the jackall, and the cat, as a specific inoculable disease, but from what peculiar source is altogether undetermined. It is probably at all times to a certain extent endemic, and occasionally epidemic among these animals. It has been supposed that it is excited in them by the great heat of the dog-days, or by the *œstus veneris;* but Troilliet has shown that canine madness occurs with nearly equal frequency in winter, spring, summer, and autumn. The poison is not peculiar to any country. Rabies is found equally in Europe, Asia, and America. Neither is it limited to climate. It prevails in the frozen regions of Canada, as well as in the East and West Indies. The difficulties attending any explanation of the origin of this poison are at present not to be surmounted; but hydrophobia once originated in the animals that have been mentioned, they have the power of reproducing it by their bite, not only in each other, but probably in all warm-blooded animals, certainly in all domesticated animals, as the horse, the elephant, the sheep, the ox, even in the common fowl, and in man. It will be necessary to the proper understanding of hydrophobia to give a short outline of the disease as it occurs in the dog, so constantly associated with us in domestic life, and the principal source of the disease in the human subject.

NB

The symptoms of this formidable affection, as witnessed in the dog, are some singular departure from his ordinary habits, such as picking straws or small bits of paper off the floor, and swallowing them; licking the noses of other dogs, or other cold surfaces, such as stones or iron. Besides this, he is observed to be more lonely, shy, and irritable; his voice is so changed that his bark would not be recognized by those who have known his voice before; and he is less eager for his food, or refuses it altogether. His ears and his tail droop; his look is suspicious and haggard; and sometimes, from the very commencement, there is a redness and watering of the eyes. In a short time saliva begins to flow from his mouth, he "slavers," his fauces may be seen to be inflamed, and he is feverish. The animal, though highly irritable and easily provoked, still obeys the voice of his master; and it is remarkable "that the dread of fluids, and even the sight of them—so striking a feature in man—is often wanting in dogs and other animals, for many dogs lap water during the disease" (YOUATT). In many dogs the symptoms never rise higher than these; but in others there is a repugnance to control, and a readiness to be aroused to extreme rage on the appearance of a stick, whip, or other instrument of punishment, or on any attempt at intimidation, which strikingly characterizes the disease. In this state, however, he seldom fights a determined battle, but bites and runs away; still even this mitigated irascibility usually ends in indiscriminate aggression, till at length he dies, apparently of convulsions or asthenia, or from mere nervous excitement and functional derangement. Majendie has inspected the hydrophobic dog, and found no characteristic morbid change. In all cases, however, in which the poison has had time to set up its specific actions, the principal lesions of structure are found to be in those parts supplied partially or entirely by the eighth pair of nerves. The tongue is swollen; the fauces, the salivary glands, and the mucous membrane at the back of the larynx behind the epiglottis, are more or less inflamed. The bronchial membrane is also occasionally inflamed, and so is the mucous membrane of the stomach, which generally contains a strange mixture of straw, hair, paper, hay, horse-dung, and earth, showing the peculiar morbid propensity of the animal; or, being void of those substances, it contains a fluid resembling the deepest-coloured chocolate. Such are the symptoms and phenomena of hydrophobia in the dog, the chief source, perhaps, of this fatal malady to the human race.

The susceptibility of the human subject to this poison is by no means universal, for only ninety-four persons are known to have died out of one hundred and fifty-three bitten, making the chances of escape as three to two nearly. It has been thought this occasional immunity does not arise out of any want of susceptibility to the action of the poison, but from the person being bitten through his clothes, and the dog's tooth, consequently, having been wiped clean from all venom. Menières, however, says he met with seven cases in which the dog must have bitten through several folds, and yet they all proved fatal; showing, as he imagines, the little importance of dress as a protection from this malady.

might at first be confounded with
Hysteria
Tetanus

Neither age nor sex is exempted from hydrophobia; but no instance is known of any person being affected with hydrophobia unless antecedently bitten by a rabid animal capable of communicating the disease.

It is a question of much moment whether the saliva of a patient labouring under hydrophobia will or will not communicate the disease. It may be stated as an undeniable fact that, during the many years hydrophobia has been studied, no instance is known of its having been communicated from one human being to another, although many instances have occurred of the attendants having been bitten, or otherwise accidentally inoculated with the saliva of the hydrophobic patient. NO The only circumstance which makes this law at all questionable is, that Majendie and Breschet inoculated two dogs with saliva taken from a diseased patient, shortly before his death from rabies, and that one dog shortly afterwards died of hydrophobia. Persons have also been seized with rabies in consequence of having wiped their lips with napkins or cloths, or other articles, which were soiled with the saliva (Enaux, Chaussier, and Aurelianus).

The dog's tooth generally implants the poison, or at least some abrasion appears to be necessary, either of the cutaneous or mucous surfaces. The ancients were aware of this, for Celsus observes that the integrity of the lining membrane of the mouth is necessary to the operation of the Psylli, whose office it was to suck out the poison after the bite of a rabid dog; and Dioscorides expressly orders them first to wash their mouths with astringent wine, and afterwards to lubricate the cavity with oil. With regard to dogs, Meynill observes that "such of them as have been thought to become affected merely by the contagion of the same kennel will generally be found, upon minute examination, to exhibit the marks of bites, though concealed by the hair." When a scratch or other abrasion exists, a rabid dog merely licking the part is sufficient to implant the poison of rabies. N.O.

Diagnosis.—When hydrophobia is fully formed there is no disease with which it can be confounded; but there are many reported cases in which the imagination of a patient bitten by a dog has been so powerful as to induce symptoms resembling the disease. In hysteria the difficulty of swallowing exists, but no other symptom. Tetanus is the disease with which rabies is most apt to be confounded; yet the differences are sufficiently marked

Distinction between Tetanus & Hydrophobia

The spasm of the muscles is more continued in tetanus; less remitting, and never intermitting. The jaw is usually much in motion in hydrophobia, in frequent attempts to clear the mouth and throat from the peculiar tenacious mucus; in tetanus it is fixed. Tetanus is rarely attended with aversion to liquids; on the contrary, the bath is grateful; nor are the tetanic paroxysms increased by the sight, hearing, or touch of fluids. Also, tetanus makes its accession usually at a much earlier period after infliction of the injury. Physiologically, while tetanus is a disease of the true spinal system, hydrophobia involves the brain also, as evinced by the disorder of intellectual function and special sense, even early in the disease. Further, the two diseases differ greatly in their mode of induction. Tetanus, in the traumatic cases, is caused by irritation of a nerve, and by disease of the spinal marrow in those which are idiopathic. Hydrophobia is the result of a specific poison introduced into the circulation, and thence affecting the nervous system as a poison would (Miller). While in tetanus the stimulus which excites the paroxysms "operates through the true spinal cord, in hydrophobia it is often conducted from the ganglia of special sense, or even from the brain, so that the sight or sound of fluids, or even the idea of them, occasions, equally with their contact, or with that of a current of air, the most distressing convulsions" (Carpenter).

Prognosis.—There are few instances of any patient or animal suffering from this disease having recovered.

Treatment.—As there are but very few authenticated cases of recovery from hydrophobia, so there are few instances of any mitigation of the symptoms by the use of medicine. All that remains is to mention the most leading experiments that have been made, with the hope that, as they have not been successful, they may not be wantonly repeated.

Dr. Hamilton gives twenty-one cases, and adds—"many hundreds more are on record," in which venesection has been unsuccessful, though frequent and copious. Opium has been given by Dr. Babington, to the enormous amount of 180 grains of solid opium in eleven hours, without the slightest narcotic effect, or the slightest mitigation of the symptoms. Nord has given a drachm of belladonna in twelve hours, without any benefit. Dr. Atterly gave to a child eight years old two drachms of calomel by the mouth, and rubbed in two ounces and a half of strong mercurial ointment in a few hours, with an equal want of success. A case, however, is related by Ligget, which is said to have been successfully treated by half-drachm doses of calomel, given to the extent of ptyalism, induced in three days, after four and a half drachms of calomel had been taken. The case really appears to have been one of hydrophobia; and recovery is said to have been complete by the twelfth day (*Amer. Quar. Journal of Med. Science*, Jan., 1860). Iron, arsenic, nitrate of silver, camphor, musk, cantharides, turpentine, tobacco, acetate of lead, ammoniacal solutions of copper, hydrocyanic acid, galvanism, strychnine, nitrous oxide, chlorine, and guaiacum, have all been given in equally large doses, but have signally failed. These include some of the most powerful medicines in the Pharmacopœia; and, in addition to these, Ploucquet, in his *Literatura Medica Digesta*, has enumerated nearly 150 others.

The failure of every remedy by the mouth, and the inefficacy of opium, of morphine, and of laurel water, even when injected into the veins, so convinced Majendie that in hydrophobia the constitution was armed against the action of any medicinal substance, that on a patient labouring under this disease being brought to the Hôtel Dieu, he determined to rely for all treatment on an injection of warm water into the veins. The patient, at the time of the operation, is represented as being absolutely insane, so as to require to be restrained. In this state, and with a pulse of 150, Majendie injected into his veins, in the course of two hours and a quarter, two pints of water, at the temperature of 100°. At the conclusion of this operation the pulse had fallen to 80, and the patient recovered his senses, so that restraint was no longer necessary. The sequel, however, renders it doubtful whether this mitigation was desirable, at the price of the intense suffering which followed. The poor man lived eight days afterwards, but the despondency and mental agitation quickly returned, and at the end of three days the poison (or the state of the blood induced by it and the warm water) appeared to set up a new series of actions on the synovial membranes of the wrists, elbows, and knees, attended with excessive pain, so that he was unable to bear the weight of the bed-clothes, and he died in great torture. The articulations thus affected were found, on *post-mortem* examination, to be greatly inflamed, and their cavities filled with pus. This case is remarkable as being the one in which life was prolonged for the greatest period of time recorded of this disease. The experiment has since been repeated by Gaspard and others; but the mitigation, if any, has been so slight and transient as to give no encouragement for repeating it; and, tried on the rabid dog by Youatt and Mayo, it proved eminently unsuccessful.

The property which some animal poisons have of controlling and of interrupting the actions of other morbid poisons on the constitution has caused even animal poisons to be tried in the cure of this disease. The rapid and powerfully acting poison of the viper led to the hope that the bite of that reptile might prove an antidote to the hydrophobic virus; but the experiment, tried in France, Germany, and Italy, upon animals, has been entirely unsuccessful. M. Grindard conceived that the vaccine virus might influence hydrophobia, and he vaccinated a hydrophobic child in three places, and afterwards injected five charges of vaccine lymph into the veins; but the child died without any marked remission, and in the usual time. The following draught has been found rather to promote euthanasia than to hold out any prospect of cure:—

℞. Spirit. Æther. Sulph., Tinct. Opii, ā ā ♏xx.; Spirit. Ammon. Aromat., ʒss.; Chloroform, ♏xx.; Mist. Camph., ℥iss.; *misce.* To be given as often as may be *considered safe* (Cunningham, Carden).

On the same principle chlorodyne ought to be given. (For its composition, see page 502 *ante.*) The vapour bath is sometimes useful in moderating spasm.

Preventive Treatment.—The probabilities are, that unless the operation of excision, or cauterization, be performed within a few minutes after the bite of the rabid animal, it is impossible to save the patient from the fatal disease, which, according to the susceptibility of his constitution, may threaten him at any moment. In all probability no prophylactic medicine exists in nature, and the administration of any potent substance by way of prevention is worse than useless; for, without protecting the patient, it may injure his constitution. Mild remedies, if they tend to tranquillize his mind and appease his apprehensions, may be innocently employed.

The theory which maintains that a zymotic incubation first takes place in the wound, by which the poison is originally implanted, suggests the most rational prophylactic—namely, to destroy entirely by *potassa fusa* the whole cicatrix, where practicable, or by some other surgical means entirely to remove it, at as early a period as possible, and *previous* to the occurrence of symptoms. When premonitory symptoms are first observed, the following plan has the recommendation of Dr. Maxwell in *The Indian Journal of Medical and Physical Science,* and of Dr. Copland, namely,—(1.) That the original cicatrix be freely laid open, and suppuration from it speedily and freely produced. (2.) The nerves, or nerve, leading to the part are to be divided without delay, the more remote from the wound the better. (3.) Free perspiration should be promoted by the hot air bath. (4.) Bleeding from the arm to syncope in robust persons with sthenic symptoms, or cuppings on the nape of the neck, are modes of practice indicated by the lesions found after death.

GLANDERS.

LATIN EQ., *Equinia;* FRENCH EQ., *Morve;* GERMAN EQ., *Rotz;*
ITALIAN EQ., *Cimurro.*

Definition.—*A febrile disease of a malignant type, resulting from the implanting of a specific poison from glandered horses. It is characterized by vascular injection of the nasal mucous membrane, from which an aqueous, viscid, glutinous, or purulent discharge proceeds, on which chancre-like sores are formed, extending to the frontal sinus and neighbouring mucous surfaces. The lymphatic glands enlarge in the vicinity of these mucous membranes. A tubercular or pustular eruption appears upon the skin, followed by suppurating, bloody, or gangrenous ulceration in various parts. A general inflammation of the lymphatics and of the glands may occur, giving rise to the small tumors known as "farcy buds" or "farcy buttons." These gradually suppurate, and secrete a specific virus.*

Pathology.—The horse, the ass, and the mule are liable to a disease termed glanders. It occurs under two forms, named respectively *glanders* and *farcy,* being "*an inflammatory affection of the skin and of the absorbent system, produced by the contagion of matter from a horse having glanders or farcy.*" Many veterinists have considered these varieties to be distinct diseases; but numerous experiments have demonstrated that they

Bud farcy = lyc glands + ar. tissue softn & ulcer
Button farcy = lyc glands & vessels only

have their origin in the common animal poison. It appears, however, that there are several grades or varieties of both these diseases. Thus, if glanders be defined to be a fever with a running of matter from the nose, farriers distinguish three kinds: one consists of swelling, ecchymosis, and gangrene of the mucous membrane, with a discharge principally from the pituitary, tracheal, or bronchial membrane; another, of a pustular eruption of the same parts, followed by ulceration; while a third consists in a combination of these two forms of disease. Of farcy, also, there are two kinds: the *bud farcy* and the *button farcy.* The "bud farcy" consists in the formation of a number of tumors on different parts of the body, as on the head, neck, and extremities, and particularly on the hinder ones, these tumors being formed not only by enlargement and inflammation of the glands, but also of the areolar tissue, and which, at the end of four or five days, soften and ulcerate. Similar tumors are said to form in the substance of the pituitary membrane, which quickly suppurate and cause death. The "button farcy" is an inflammation limited to the lymphatic glands and vessels, without involving, in any considerable degree, the areolar tissue. It usually commences in the hinder extremities, causing lameness and enlargement of the limb: and when the valves of the lymphatics become thickened, it forms a tumor called the "farcy bud;" while if the lymphatic vessel itself be inflamed, it is termed "farcy pipe." It may be shortly stated, that in *glanders* the nasal passages especially suffer; while in *farcy* it is the lymphatic system which is affected.

The mildest form of all is that named "Equinia mitis," and thus defined:—"*A pustular eruption, produced by the contagion of matter from a horse affected with 'the grease.'*"

It has been determined by a number of severe accidents occurring to persons employed about glandered horses, that the poison producing them is capable of being transmitted from the horse to the human subject, and again from the human subject to the horse and to the ass; and there is reason also to believe that it is capable of being transmitted from one human being to another (Zimmerman, in *Virch. Arch.*, vol. xxiii., p. 209, and *Year-Book of New Syden. Society*, 1862). The attention of the profession was first called to this interesting subject by Mr. Muscroft, in *The Edinburgh Medical and Surgical Journal,* in the year 1821, where he relates the case of the whipper-in of the Bradworth hunt, who wounded himself in cutting up a glandered horse for the kennel, and died, at the end of a week, of confirmed glanders; and two similar cases appeared in the same work about two years afterwards. Simultaneously with Mr. Muscroft, Dr. Copland, in the course of a discussion at the Medico-Chirurgical Society of London, stated that the fact of the disease having been thus communicated had been proved by cases that had occurred in Germany, and which were published in *Rust's Magazine* for 1821. The cases excited but little notice till Mr. Travers published his valuable work on *Constitutional Irritation*, in 1828, containing a letter from Professor Coleman on the transmission of glanders from the horse to man, and from man to the ass, together with some other cases which had fallen under his own observation. The subject was now followed up by Dr. Elliotson, in two papers in the *Transactions of the Medico-Chirurgical Society*, narrating three cases which had occurred in his own, Dr. Roots's, and Dr. Williams's practice. At length all the then known facts were collected in an elaborate paper by Rayer, in the sixth volume of the *Mémoires de l'Académie Royale de Médecine.*

In the cases collected by Rayer, the nose and nasal fossæ had only been examined in four cases out of fifteen, and in these there was found either ecchymosis, ulceration, or gangrene of the mucous membrane of the *septum nasi*, or of the sinuses. The mucous membrane of the larynx, or trachea, has likewise been found studded either with the peculiar eruption, or diffusely inflamed or ulcerated, so much so that in one case the epiglottis was in part destroyed. The lungs have likewise been found either gorged with blood, or the seat of lobular pneumonia, or of vomicæ, with typhoid symptoms—*broncho-pneumo-typhus*, as it is called in Germany. In Dr. Roots's case there was an encysted abscess of the lung, which contained about two ounces of pus. Besides these affections of the more vital organs, a number of small farcy tumors have been found in different parts of the trunk and extremities, and perfectly remote from the point originally punctured. These tumors were in different states of inflammation, some being white and indurated, others soft and injected, and others in a state of suppuration. In Dr. Roots's case an abscess on the back of the hand communicated with the articulation of the metacarpal bones; and in another case an abscess had opened into the knee-joint. The absorbent vessels have likewise

(Ac/ Fever:
Pains in limbs
Purulent disch: from nose,
Pustular eruption on skin
Typhoid symptoms

been found inflamed along the arm from the point of puncture, or site of primary inoculation, and the glands to which they lead have been found enlarged and indurated, or in a state of suppuration.

The result of all these observations shows that in cases of glanders a specific poison is implanted which infects the blood, and, after a given period of latency, produces, in slight cases, an abscess at the point of puncture, followed by some tumors in the course of the absorbents connected with the punctured part. In severe cases fever is previously set up, and after this has continued for some days, there follows either a diffuse or an eruptive inflammation of the mucous membrane of the nostrils and of the trachea, terminating in suppuration, ulceration, or gangrene; also some inflammatory affection of the lung, together with the usual farcy button or bad tumors in different parts of the body.

Symptoms.—Glanders may be either acute or chronic. Acute glanders is expressed by primary fever, followed by local inflammation; chronic glanders, is when the local inflammations exist *per se.*

The acute disease is ushered in by an attack of primary fever, with or without rigors, and followed by pains in the limbs so severe as often to be mistaken for an attack of acute rheumatism. Some days after, the pained parts become the seat of phlegmonous tumors, accompanied with much pain, redness, and tenderness; these more commonly terminate in abscess, sometimes discharging a laudable pus, but more usually a bloody sanies, and rapidly become gangrenous. Towards the close of the disease, in almost all cases there has been a discharge of matter more or less purulent, viscid, and mixed with blood, from the nostrils. The quantity, however, has in general been inconsiderable, and sometimes scarcely appreciable. The period at which this symptom appears is not constant. It has been seen as early as the fourth, and as late as the sixteenth day. In the course of the disease the eyelids are generally tumefied, and discharge a thick viscid matter, like that from the nose; and enlargement of the submaxillary glands occurs.

One of the most remarkable symptoms of acute glanders in man is the eruption of pustules on the face, trunk, limbs, and genital organs. This eruption has been compared to *varicella,* to *small-pox,* and to *ecthyma;* but in fact it is an eruption *sui generis,* and cannot be compared to any other. It has been observed to occur about the twelfth day, and to be preceded and accompanied by profuse fetid sweats. Besides this eruption, a number of black bullæ have been observed on the nose, forehead, below the ears, on the fingers, toes, and genital organs, and these have been followed by gangrene more or less extensive and deep.

The pulse is full and quick in the early stages, but towards the close it becomes rapid, small, irregular, and even intermittent. The tongue varies, as in typhus, being first white and coated, and subsequently brown or black. Diarrhœa and meteorism often complicate the disease, and blood has been observed in the stools. Cerebral disturbance has come on as early as the second day, but more commonly not till towards the tenth; sometimes marked by a singular want of intelligence, at others by a sinister presentiment, followed by stupor and death.

Acute glanders is rapid in its course, and two-thirds of the cases have terminated before the seventeenth day; some have died on the twenty-first day, a few on the twenty-eighth day, and only one has survived till the fifty-ninth day.

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Chronic glanders, or farcy, differs from acute glanders in the circumstance of the local lesion preceding the general febrile derangement, the introduction of the poison being followed in a few hours by inflammation of the lymphatics proceeding from the wounded part, and extending sometimes to the elbow or axilla, and involving the axillary glands. These effects are followed by inflammation and extensive abscesses in the subcutaneous cellular tissue, often involving the whole limb. From this state the patient may recover; but should these abscesses be multiplied over various parts of the body, and be accompanied either by the pustular or gangrenous vesicular eruptions, or by both, the result is generally fatal; hectic symptoms supervene, and hasten the final catastrophe.

The disease has terminated within a fortnight, but more commonly it has not proved fatal till the end of a month; and, in cases still more chronic, a twelvemonth has been known to elapse before the patient finally recovered or died. Such are the general phenomena of acute and chronic glanders, as they have been observed in the human subject.

Cause.—The remote cause of glanders in the horse is but little understood. It is probably due to a specific miasmatic poison, having a peculiar affinity for the horse, and animals of his class.

Glanders, however, when it affects the human subject, has in all instances been distinctly traced to the glandered horse as the remote cause. No instance is known of the disease occurring primarily in man.

In the horse certain predisposing causes greatly favour, and are perhaps necessary to, the spread of glanders, such as dirty, close, ill-ventilated stables, especially if the situation be low and damp. Horses when crowded on board transports are greatly liable to this affection. The Arab, in transporting his horses from Arabia to India, always chooses that part of the year when the passage is shortest, lest the accidents incident to a long voyage might oblige the hatches to be closed, and want of ventilation promote the development of glanders. Bad food is a powerful predisposing cause in the horse, especially when these animals are picketed on service, and thus exposed to the inclemency of the weather. At the close of a campaign the cavalry are often decimated by this disease, and towards the termination of the Peninsular war the losses from this cause are said to have been enormous. The cases occurring in the human subject are too few to allow of any inference being drawn as to the influence of the predisposing causes in the production of glanders; but the disease generally occurs in young men; and probably a close investigation would have shown that the habits of the patient were such as to fall within those laws which favour the production of the disease in the horse.

The majority of veterinary surgeons, of stable-keepers, and coach proprietors, believe that the disease is contagious among horses, and if a glandered horse has been introduced into stables, the stock in these stables have become diseased. There are few districts in which some farmer, by the loss of a considerable part of his team, has not had sufficient proof of the communicable nature of glanders. In this country the law is severe against offering for sale, or even working, a glandered horse; which shows that the opinion of our ancestors, time out of mind, has been that glanders is a contagious and a fatal disease. In Germany the belief of contagion is so general that it is said the law directs any horse that has been in contact with a glandered animal to be immediately killed. Again, Professor Coleman has produced glanders by direct inoculation from horse to horse; so also have Professors Peal and Renault; while Leblanc assures us that he has repeated these experiments till he has demonstrated that not only is glanders contagious, but that farcy and glanders are mere varieties of the same disease,—the farcy matter producing glanders, and the matter of glanders producing farcy.

Cases of the transmission of glanders from the horse to man are now numerous; and that the disease is actually glanders has been shown by Professor Coleman, who directed two asses to be inoculated with matter taken from the arm of a person then labouring under this disease, consequent on a puncture received in dissecting a glandered animal, and both animals died of glanders. These experiments have been repeated, with similar results, by Gerard, Hering, of Stuttgardt, and more recently by Leblanc, with matter taken from a patient that died glandered under the care of Rayer, so that no doubt can exist of the fact. It seems proved, therefore, that glanders is transmissible from the horse to man, and again from man to the ass. It has been contended, also, that if glanders is transmissible from man to animals, the disease must be capable of being communicated from one human subject to another; and a case of this description appears actually to have occurred in St. Bartholomew's Hospital about twenty years ago, when the nurse, a healthy woman, contracted the disease from a patient in the ward, and, after a short illness, died with every symptom of glanders.

The fact of repeated inoculation with glandered virus distinctly shows that fomites may be so infected as to produce the disease. The spread of the malady has been attributed to healthy horses having drunk out of the same pail or trough with a glandered horse, or to licking the neighbouring rack or partitions of the stalls in which a glandered horse had been placed. Mr. White attributes the occurrence of glanders in a mare and two foals to some hay left by a team of glandered horses being blown into their paddock.

The specific poison of glanders has been introduced into the system both by the cutaneous and mucous tissues. The disease has been produced by inserting the virus under the cutis with a lancet, and by rubbing it on the greasy heel of a horse; it has also been produced by inoculating the mucous membrane of the nose of the horse, or by smearing that membrane with farcied matter. Farcied matter has also been made up into balls, and introduced into the stomach of the horse, and glanders has

Incubation 2 - 8 days

resulted. There can be no doubt, therefore, that the poison is absorbed both by the cutaneous and mucous tissues, and that, being absorbed, it infects the blood. This latter fact has been distinctly proved by Professor Coleman. "I have," says this gentleman, "produced the disease by first removing the healthy blood from an ass, until the animal was nearly exhausted, and then transferring from a glandered horse blood from the carotid artery into the jugular vein of the ass. The disease in the ass was rapid and violent in degree; and from this animal, by inoculation, I afterwards produced both glanders and farcy. In acute glanders, therefore, the blood is undoubtedly affected."

Period of Latency.—The poison of glanders has its period of latency, like all other morbid poisons, and that period is in general short. Two asses were inoculated by Mr. Turner, the one about a year and the other a year and a half old, and in the first the maxillary glands became tender on the second day, and the discharge from the nostrils was established on the third. In the other the maxillary gland enlarged on the third day, but the discharge from the nostrils did not take place till the sixth day. Sometimes, however, the incubation is much longer. In the *Procès-verbal de l'Ecole de Lyon* a case is given of a horse which was inoculated with farcy matter, but the disease did not appear till the end of three months, and then precisely at the points of puncture. M. Gerard, an ex-veterinary surgeon of the French "artillerie de la garde," states that he introduced the matter of the discharge every day into the nostrils of certain horses, by means of a brush, and that the disease appeared in one on the seventh day, but in two others not till the thirty-second day.

In the human subject the poison has in general been latent from two to eight days after the accident of inoculation.

Prognosis.—Of fifteen cases of acute glanders collected by Rayer only one recovered. Of fifteen cases of acute farcy only five recovered. Of seven cases of chronic farcy only one died. Of the three cases of chronic glanders two died. A favourable prognosis, consequently, is only warranted in the chronic form of the disease.

Diagnosis.—"Acute glanders," says Rayer, "cannot be confounded with poisoning from puncture in dissecting or opening dead bodies; for," he adds, "out of fifty such cases reported by various authors, no mention is made in them of a discharge from the nostrils, or of a nasal or laryngeal eruption being found after death, or of the peculiar cutaneous eruption." Leblanc also states that he has inoculated the horse with a great number of other morbid secretions from the human subject, but has in no instance produced any disease similar to glanders. It may for a short time be mistaken for rheumatism, but the occurrence of the secondary actions quickly dispels this error.

Treatment.—All the remedies hitherto tried in acute glanders have failed. The coming on of typhoid symptoms has led to the administration of *quinia, valerian, serpentaria, ammonia,* and other stimulating medicines; but all of them have failed. Vomiting and purging have likewise been had recourse to; but these measures have been equally unsuccessful. It is probable, therefore, that the cure of this disease depends on the discovery of a specific remedy, and experiments in treatment may be warranted as the only chance of subduing a malady which has so constantly proved fatal. In the more chronic forms of the disease the recovery of the patient has appeared to be owing to the excellence of his constitution during the natural elimination of the poison, to good ventilation, and to generous diet, rather than to any powerful effect produced either by general or local treatment.

Preventive Treatment.—The prophylactic treatment is the same as that of all other contagious diseases—namely, being careful to avoid all contact with the morbid poison, and especially when a finger or other part of the hand is abraded; and if by accident the veterinary surgeon should inoculate himself, he ought instantly to destroy the part with *potassa fusa.* It has been recommended, after the disease is set up, to extirpate the enlarged glands; but according to the doctrines set forth in the text, this practice is as unwarrantable as hopeless.

MALIGNANT PUSTULE (VESICLE?).

Latin Eq., *Pustula pestifera;* French Eq., *Pustule maligne;* German Eq., *Milzbrand*—Syn., *Karbunkel-krankheit;* Italian, *Pustula maligna.*

Definition.—*The result of a specific poison implanted on some uncovered part, which produces, in the first instance, a redness like the bite of a gnat, and afterwards a minute vesicle. A peculiar form of spreading gangrenous inflammation is excited, which rapidly spreads from the point first affected to the neigh-*

bouring tissues. Hardening and blackening of this part is so extreme, and death of tissue is so entire, that the part creaks when cut with a knife—no pain attends the incisions, crops of secondary vesicles form round an erysipelatous-like areola, chains of lymphatics become inflamed, the breath fetid, and death follows amid all the indications of septic poisoning (BUDD).

Pathology and Historical Notice.—This disease has been long familiarly known and described by French, German, Russian, Swedish, Lapland, and Italian medical men; and it proves fatal every year to a large number of persons in various parts of Europe. British medical men are not generally familiar with the disease; and its occurrence in this country escaped general recognition till the admirable papers of Dr. William Budd on the subject (read at the meeting of the Medical Association in London, and published in the *British Medical Journal* of 1863) gave a full account of the literature of the subject, and showed that malignant pustule has been long known in this country as an epizoötic, causing every year a large mortality among English live stock. The "*joint murrain*," "*black quarter*," or "*quarter evil*," and the "*blood*" (the name by which the malady is known in the sheep), are the same diseases as the "*charbon*," "*quartier*," and "*sang*" of the French, and the "*milzbrand*" of the Germans. From the writings of Dr. Budd on this subject the following account of this remarkable and terrible disease is taken. The disease has prevailed from time immemorial, in various continental countries, in oxen, sheep, horses, and other animals; and, concurrently with the cases of malignant pustule, which are the result of direct inoculation from the morbid material of those animals, other cases occur in which the exact vehicle of the poison cannot be identified; but these cases have all the significant peculiarity, that the disease is always *seated on some part of the person which is habitually uncovered.*

In animals, and especially in oxen, the action of the specific poison seems to be even more virulent than it is in man. Death is more speedy; there is a more rapid spread of gangrene; and while the animal is yet living, the extrication of fetid gases from the tissues of the parts affected goes on to a great extent. The contagious property of the poison is possessed in the highest degree by the lymph contained in the characteristic vesicles, and, next to this, by that peculiar exudation which occurs in the

Inoculation directe
Working hides
Insects
Eating the flesh

areolar tissue of the affected part, and in that of various parenchymatous organs, and sometimes in the serous cavities of the chest and abdomen. The identity of the malignant pustule of man with the "*charbon*" of cattle has been satisfactorily proved, by the fact that the disease, when contracted by man, has been communicated back to the animal by inoculation from man.

It is only at the onset that the disease is a local one; but very soon general poisoning ensues, which is due to the after-diffusion of the morbid changes and products engendered in the part first affected. This is a very important point in the pathology of the disease, and with a view to successful treatment; for the early destruction of the diseased part by caustic not only prevents the development of the constitutional disorder, but in many cases issues in a perfect and speedy cure.

Propagation.—The disease may be communicated to man in the following ways:—(1.) By direct inoculation, as in the case of butchers, farmers, skinners, herdsmen, drovers, and others, in whom accidental inoculation with it appears to be an event of no uncommon occurrence in countries where "*charbon*" is most rife. (2.) By means of the skin, or simply by the hair of diseased beasts. Trousseau, for example, relates that in two factories for working up horse hair, imported from Buenos Ayres, and in which only six or eight hands were employed, twenty persons died in the course of ten years from malignant pustule. There are many other cases related by Dr. Budd, and some which clearly show that the virus of *malignant pustule,* like other contagious poisons, when once in the dried state, may retain its powers for an indefinite period of time. The disease may thus be propagated through contact with bones, hoofs, horns, and the fat and tallow of animals dead of the "*charbon.*" (3.) The disease may be communicated by eating the flesh of animals killed while affected with it, as also by using the milk and butter of affected cows. (4.) Insects which have been in contact with the bodies or carcases of diseased cattle may communicate the disease to man. Most commonly it is the insects with piercing probosces, such as gadflies, after having sucked the putrid juices of dead or sick animals, and then settled on the persons of men, which effect the inoculation; but flies which make no wound may also implant the poison on the skin by their soiled wings and feet (VIRCHOW, BOURGEOIS). The latter observer says "he has seen the disease produced by the puncture of a gad-fly which came out of a fleece of wool" (BUDD).

Phenomena and Symptoms.—A considerable degree of pruritus in the part is succeeded by the appearance of a red spot like a flea-bite. A vesicle, in the course of twelve or fifteen hours afterwards, may be observed, at first about the size of a millet seed, but very soon it acquires larger dimensions, and, if not ruptured by the patient, bursts spontaneously, and dries up in about thirty-six hours, leaving the exposed *cutis vera* dry, and of a livid colour. Twenty-four or thirty-six hours after the attack (itching having now ceased), a small, hard, and circumscribed nucleus—the "*parent nucleus*" of Virchow, the "*maltka*" of the Russians—having the form and size of a lentil, is perceptible under and around the seat of the vesicle. In the circumference of this a soft but still resisting swelling, of a reddish or livid colour, forms an inflamed areola, and becomes covered eventually with secondary sero-sanguinolent vesicles, similar to the vesicle which first appeared. These are at first isolated, but speedily they become confluent. The central spot may contain at first a transparent, bright yellow fluid, which very early becomes reddish or bluish; then of a brownish hue, when the spot becomes extremely hard, very insensible, and rapidly becomes gangrenous. The inflammation extends to a considerable distance, both in depth and circumference; the neighbouring skin is red and shining; the subcutaneous areolar tissue is puffy and emphysematous-like; the excoriated surface readily dries up, and becomes, as it were, mummified; and in its neighbourhood new vesicles spring up, which run the same course as the former. The part soon loses its vitality, so that it may be pierced with needles without the patient becoming aware of it. It is also a remarkable feature of *malignant pustule*, that severe pain is generally absent. If the disease ceases to advance, an inflamed circle of vivid redness now surrounds the gangrenous portion, the tumefaction diminishes, and the patient experiences something like an agreeable warmth, accompanied by a pulsatory motion of the affected part. The pulse, which before was irritable and feeble, begins to revive, strength increases, a gentle perspiration indicates the crisis of the febrile state, and nausea ceases. Separation commences between the living and the dead parts, and is attended by copious suppuration. If the disease should not tend to a favourable issue, suppuration does not take place; the gangrene spreads rapidly; the pulse becomes smaller and more contracted; the patient suffers from extreme lassitude and inability to sleep; and, finally, with a tendency to syncope, he becomes passive as to the result. The tongue is dry and brown, the features shrink, the skin is parched, the eyes are glassy; and cardialgia and low delirium indicate the approach of the fatal termination (BUDD, RAJER, VIRCHOW, BELL, CRAIGIE).

The face (often in the lip, or immediate neighbourhood of the mouth), the neck, the hands, the arms, and the legs are almost the only parts on which it appears; and if by chance it becomes developed on other parts, we may be sure the poison has been carried there directly by the fingers, or other agents impregnated with the virus. The phenomena, therefore, which such cases exhibit in man are identical in every particular with those which have been seen in farriers, and others in continental countries who have the charge of cattle, and who in numberless instances are known to have become diseased from the accidental but direct inoculation of the "*charbon*" virus.

Treatment.—The affection only admits of cure when to the uninformed its aspect is trivial; and it can only be cured by a process which leaves a mark. To make an abiding scar on the face, for the treatment of what, at the worst, appears to be no more than a common boil, is a serious consideration for the reputation of the medical man in his practice amongst ignorant people.

The progress of the disease is only certainly to be averted by the use of caustics; and of the various caustics in use the evidence appears to preponderate in favour of *potassa fusa;* although Chaussier and others prefer *nitric acid* or the *chloride* of *antimony.* But everything hangs on the recognition of the disease in its first stage (BUDD).

SYPHILIS.

LATIN EQ., *Syphilis;* FRENCH EQ., *Syphilis;* GERMAN EQ., *Syphilis;* ITALIAN EQ., *Sifilide.*

Definition.—*The result of a specific poison implanted on some part of the body, but generally through an abrasion or sore consequent on sexual intercourse with an infected person. A peculiar series of phenomena supervene, which mark the general infection* *of the system. The principal anatomical signs of general infection consist of induration (specific) round the spot where the virus has been implanted, induration of the lymphatic system of glands, the formation of nodes or gummatous nodular tumors in the connective tissue generally, and especially in that of the true skin, bones, mucous membranes, and solid visceral organs*—e. g., *liver, brain, lungs, and heart. A cachectic condition of the system accompanies the phenomena of infection; and indurations may remain in the form of hardened fibrous tissue in various parts of the body for an indefinite period of time.*

Pathology and Morbid Anatomy.—Advances in Pathology of late years have not been more marked in any direction than in demonstrating the very remote effects which syphilitic infection exercises upon the organs and the constitution of man. These advances are due to clinical, experimental, and *post-mortem* observations. They have shown that a considerable number of doubtful cases of ill-health are in reality due to the specific poison of that venereal disease to which the name of *syphilis* is now restricted, whose morbid effects are not fully developed till many days, months, and even years after inoculation. Hitherto surgeons have claimed the subject of *syphilis* as their peculiar field; but after the surgeon had healed the sore, the morbid influence of the poison in many cases still remained, and internal lesions, impaired health, and degenerate constitution, eventually brought the patient to consult the physician as well as the surgeon.

The pure surgeon and the pure physician must, therefore, condescend to forget their purity, if they would comprehend the pathology of this disease; for the relations of syphilis are so vast and complicated that the physician, as well as the surgeon, must combine their knowledge and their skill, before the many interesting points in the pathology of syphilis can be fully cleared up. To heal the original sore and obtain a cicatrix is but the beginning of the end.

It is partly to this unscientific division of the wide field of medical practice that the phases of opinion regarding the pathology of syphilis have been so remarkably diversified. *The surgeon* alone saw the primary sore or inoculation, and only by chance he might see the development of the future lesions, now so important in pathology. *The physician,* on the other hand, rarely saw the primary sore; and when he now sees the victim of secondary and tertiary syphilis, the case is often extremely complicated, "mixed up with and overlaid by other constitutional and local diseases," which in their turn are made more serious by the existence of syphilis.

After a period, indeed, of scepticism and doubt, we are now confirming, by actual observations (aided by all the advanced knowledge and appliances of the day) the crude surmises of the early physicians regarding the pathology of syphilis.

It was taught by Sir Astley Cooper that "some parts of the body are incapable of being acted upon by the venereal poison, as the brain, the heart, and the abdominal viscera. Indeed," he writes, "this poison does not appear to be capable of exercising its destructive influence on the vital organs, or on those parts most essential to the welfare and continuance of life" (*Lectures on Surgery*). The very reverse of this is now proved to be the truth; and the physicians of the sixteenth century were more advanced in their views than one who was among the most eminent surgeons of the present century.

Towards the close of the fifteenth century a great epidemic of syphilis pervaded Europe; and the historians of the disease described a form of neuralgia as one of the remote results of the venereal poison. In the sixteenth century syphilis was clearly recognized as the result of a specific poison or virus. It was believed to be capable of combining with all other diseases, and so to modify them, and to give them new forms. Even at that early period in medical history, syphilis was recognized as producing phthisis, diarrhœa, dropsy, skin diseases profoundly affecting the system, and demonstrating the presence of a poison in the system by remote general symptoms of ill-health (PARACELSUS). Towards the close of the seventeenth century the ulterior results of venereal disease were fully recognized; but they were believed to be due to bad treatment. Van Swietan taught that *no organ* escapes the influence of the venereal poison. He recognizes it as the source of gummy tumors, exostosis, deep-seated pains, apoplexy, epilepsy, blindness, deafness, paralysis. Benjamin Bell is the first writer on syphilis who puts forth clinical facts in support of his belief that "the venereal disease induces blindness, amaurosis, deafness, phthisis, rheumatism, epilepsy, mania."

There is no disease which more imperatively demands the careful study of the profession at this time, and especially of the army medical officer. The specific distinctions between the "infecting" and the "non-infecting" poison, and the characteristic phenomena they induce, are now being recognized at most of the continental schools. They are distinctions which are of great value in practice, and likely to become more valuable as our knowledge becomes more defined. Even now, indeed, when we see *a primary sore,* AND WATCH IT, we are able to predict with absolute certainty, at an early period of its development, whether the patient will or will not be the subject of secondary symptoms.

A history of syphilis in soldiers is too often the starting point of a fatal disease. The impairment of the health takes its origin from the date of the *infecting* syphilitic sore. Early implication of the lymphatic glands leads to impoverishment of the blood as an immediate result, and then to the degeneration or wasting of tissues, which attends the general cachexia, and which eventually terminates in death, with complicated and varied lesions especially implicating the internal viscera.

No statistical Nosology gives any idea of the number of men lost to the public service from *syphilis.* The loss of strength from venereal diseases alone is equal to the loss of more than eight days annually of every soldier in the service. Dr. Balfour relates, in his most excellent and interesting *Medical, Sanitary, and Statistical Report of the Army Medical Department* for 1860, that "more than one-third of all the admissions into hospital have been on account of venereal diseases (369 per 1,000); and the average number constantly in hospital is equal to 23·69 (reduced to 19·10 in 1864) per 1,000 of strength (2,315 men), each remaining in hospital on an average 23½ days. Thus the inefficiency is constantly equal to about 2½ regiments." Dr. Balfour also observed the individual history of 1,126 men of the Grenadier Guards for three years and five months: 536 of these men gave rise to 1,250 admissions; 212 were admitted *once;* 146 *twice;* 70 *three times;* 55 *four times;* 24 *five times;* 19 *six times;* 6 *seven times;* 2 *eight times;* 1 *ten times;* and 1 *fourteen times.* These figures have great practical significance. But They do not tell us how many of these men became constitutionally contaminated by syphilis. They do not tell us in how many the development of "pulmonary lesions of tuberculous inflammation" could be traced to the influence of an "*infecting*" sore; nor how many afterwards became affected with those lesions of internal organs about to be described, whose characters are now so well defined and characteristic of syphilitic infection.

The Director-General of the Army Medical Department very properly requests that "all venereal ulcers be fully described, and the case fully kept;" and if such a request were complied with in the fullest sense of the term, most valuable results would accrue to science. From the nature of the facts and data about to be considered, the great importance of this request will at once appear; and the necessity of describing most fully, distinctly, and clearly the origin, development, and results of venereal sores, as far as possible, will appear obvious.

With a view to this accurate investigation and recording of results, the following points are worthy of notice:—

1. The nature of the contagious principle of the syphilitic poison, as expressed in the opinions of the most trustworthy observers in this and other countries.

2. The characters and the phenomena which distinguish a sore that will contaminate or infect the system, and one which will not.

3. The vehicles or media by which the specific or "*infecting*" virus may be inoculated.

4. The secondary lesions and local growths in the internal viscera which are now so uniformly found to be associated with a history of syphilis, and which are the remote effects of a specific venereal poison.

1. **Nature of the Syphilitic Poison.**—The disease develops itself after the introduction of a specific virus; and the source of the poison is more distinctly traceable than that of the miasmatic order of diseases. The actual substance or matter which contains the virus can be obtained, and can be inoculated. Yet the *active principle* of the poison has not been isolated by any chemical process; and in this respect it is in exactly the same position as the poison of small-pox. The poison of syphilis undergoes a multiple process of elaboration or development in the system before its full effects are completed; and the lesions it induces demonstrate some of the most interesting points in the pathology of the multiplication or reproduction of morbid poisons. It is this multiplication which ultimately destroys life, through a general degeneration of the tissues and the establishment of a cachexia

already referred to; or by the induction of grave lesions in important visceral parts, such as the brain, the lungs, the liver, or the kidney.

The earliest effects of the syphilitic poison upon the system become established during the occurrence of a "*hardening process*" which ultimately surrounds an infecting venereal sore—the local papule and its subsequent ulcer or sore. This hardening process is peculiar; and although not constant as to the local sore, it is constant as regards the glands or lymphatics which proceed from the vicinity of the part inoculated. It occurs in one or other of the three following conditions:—(1.) Hardening or induration of *sore* and *glands;* (2.) Hardening and induration of the *cicatrix* and *glands;* (3.) Hardening and induration of *lymphatic glands* only, the original local lesion never having become hard (SIGMUND).

From these specific and characteristic local conditions, as from a focus, the system eventually becomes contaminated. The steps or sequence of phenomena associated with this contamination are not yet clearly understood; but as the contamination is expressed by very constant and specific characters, it is obvious that the original virus has become *intensified* in its action (as is also the case with the virus of hydrophobia), its pernicious influence more active and obvious, while its specific secondary and tertiary effects become more fully and extensively developed. These secondary lesions of syphilis are even now known in some forms to be inoculable.

The following classification and definitions of the forms of syphilis may be given:—

A. *Primary Syphilis.* Definition—*Syphilis while limited to the part inoculated, and the lymphatic glands connected with it.* The varieties are *hard chancre, indurated bubo; soft chancre, suppurating bubo; phagedenic sore; sloughing sore.*

B. *Secondary Syphilis.* Definition—*Syphilis, when it affects parts not directly inoculated.*

Tertiary syphilis is a term sometimes applied to the later symptoms, when separated by an interval of health from the ordinary secondary syphilis.

C. *Hereditary Syphilis.* Definition.—*Constitutional Syphilis of the child, derived during fœtal life from one of the parents.*

Nomenclature.—*Syphilis,* comprehending primary and successive constitutional symptoms of contamination, ought now to be distinguished from simple *venereal* ulceration not followed by gland complication nor contamination of the system. The etymology of the term "*syphilis*" is unknown; but as now used, the term ought to comprise (1.) the primary and (2.) the successive constitutional symptoms or phenomena which denote the contamination of the system. A man may have had a chancre and a suppurating bubo, and yet remain free from any taint. Such a case should not be set down as a case of syphilis, but simply as a case of "*venereal ulceration*" *with glandular complication.* In such a case the gland complication is consequent on the irritation of the sore, and is not specific.

Syphilis should be reserved to designate the more serious affection, in which the constitution is implicated, and in which the infecting phenomena occur; and if the term "chancre" is used, it should be stated[*] whether it is a "*soft*," "non-infecting chancre," or an "infecting" one; otherwise, diagnosis is incomplete.

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[*] The following very excellent directions have been drawn up by my colleague, Mr. Longmore, the Professor of Military Surgery in the Army Medical School, to be attended to in recording cases of primary venereal lesions (exclusive of gonorrhœa), and their consequences, among patients in the wards of the Royal Victoria Hospital at Netley. These directions are in accordance with our present knowledge of the Pathology of Syphilis.

"1st. The term '*syphilis*,' or '*syphilitic*,' when used in the case-book, is to be applied only to such cases as are believed to be of a *specific infecting* kind. Non-syphilitic venereal lesions are to be named according to their local and physical characters, as '*superficial abrasion*,' '*ulcus*,' and the like.

"2nd. The following five points are to be noted in entering the history of each venereal case in the case-book:—

"I. Physical characters and exact site of the lesion. II. Period of incubation. III. Character of attendant inflammation. IV. Effects on neighbouring glands. V. Prognosis.

"3rd. Under I. 'Physical characters and exact site of lesion,' state whether,

"(A.) The lesion has the appearance of a papule: fissure: an abrasion: of a dry, or moist, open sore; whether, if a *sore* exists, it is superficial, not appearing to penetrate the whole thickness of the integument: or deeper, with a smooth surface, scanty, chiefly serous secretion, greyish in the centre; whether the texture around the lesion is indurated, and, if so, what is the character of this induration, especially whether it is circumscribed, cartilagenous-like, and appears to be distinct from the subjacent and surrounding tissues; or whether,

"(B.) An excavated sore exists, with abrupt defined edges, involving the whole thickness of the integument, with an uneven surface, covered all over with copious secretion, and without circumscribed induration.

"*Mem.:* The induration which exists from simple inflammation excited by the rubbing of clothes, the probability of which the site of the sore will perhaps

2. Characters of Venereal Sores, and especially of the "Infecting Sore."—There are several independent affections to which the common name "Venereal" has been applied, each capable of transmission from person to person within certain definite periods. From time to time it has been a subject of discussion, "Whether

indicate, or by the use of irritating applications, such as nitrate of silver, &c., and which disappears gradually in the surrounding tissues, must be carefully distinguished from the circumscribed hardness characteristic of the true syphilitic sore.

"If more than one sore exist, it must be noted whether the several sores appeared together from the first, or appeared in succession.

"If some time has elapsed since the patient was first taken under treatment, the *original* form and appearance of the sore should be traced as far as possible, and noted whether it began as a pimple, abrasion, fissure, or otherwise.

"4th. Under II. 'Period of Incubation,' should be ascertained and stated whether,

"(A.) The lesion first appeared after a lapse of one week, or from that time to a month, after exposure to contagion; or whether,

"(B.) There was no period of incubation, the sore appearing within a week after exposure.

"*Mem.:* The importance to the patient of the questions at issue should be frankly explained to him, and his confidence secured, so that he may be induced to state as exactly as he can the number of times he has been exposed to contagion within a period of four or five weeks prior to his discovering the existence of the lesion. A patient usually himself dates the origin of the lesion from the time when he was *last* in the way of contracting disease. He may, however, have been in the way of contracting disease many times *after* the particular occasion on which he really contracted it.

"5th. Under III. 'Character of attendant inflammation,' state whether,

"(A.) The inflammation appears to be of the adhesive, or whether,

"(B.) Of the suppurative or phagedenic kind.

"6th. Under IV. 'Effects on neighbouring glands,' state whether,

"(A.) The superficial inguinal glands are, on one or both sides, generally and separately indurated, the inflammation with which they are affected being of an indolent character and without pain; or whether,

"(B.) The glands are free from enlargement; or whether one or more of the glands are enlarged, and exhibit a tendency to suppurative action.

"7th. Under V. 'Prognosis,' state whether you consider the case to be one of (*a.*) syphilis, or (*b.*) of local venereal sore, or (*c.*) of a doubtful nature.

"If the circumstances described under (A.) exist, the conclusion will be that the lesions are indicative of the constitution being affected by syphilis; if those described under (B.) exist, the conclusion will be that the lesions are local.

"If your prognosis is doubtful, state the considerations which cause it to be so.

"If the prognosis that the patient is afflicted with syphilis be correct, then the specific sore will not be capable of repetition on the same person by inoculation; if the prognosis be correct that the sore is a simple one, then the sore will be capable of indefinite repetition on the subject of it by inoculation.

"If your prognosis is doubtful, regard the disease as local until further observation establishes a contrary opinion."

these *several affections* are due to one and the same virus, whose action is modified by admixture with secretions, or by peculiarities of constitution on the part of the recipient?" or, "Whether a separate specific poison exists for each form of venereal disease?" This latter alternative is now proven to be true; and the following are the classes of venereal affections which are specifically distinct:—(*a.*) Gonorrhœa; (*b.*) "Simple" "non-infecting" chancres, ulcers, or sores; (*c.*) "Infecting" chancres, papules, ulcers, or sores; (*d.*) Mixed chancres—the combined result of the virus of (*b.*) and (*c.*); (*e.*) Subsequent lesions retaining specific powers of contagion (some forms of secondary syphilitic lesions).

The History of the identification of the nature of the separate poisons which give rise to the several venereal affections arranges itself into three periods as to time, and is comprehended in the medical records of the past century.

I. *The Period and Doctrine of Hunter—The Hunterian Chancre.*—Hunter taught the doctrine (now known to be an error), "That the various forms of syphilis and gonorrhœa depend upon one and the same poison—that the matter or virus produced in both is of the same kind, and has the same properties. He believed that he had established, by experiment and observation, that the discharge from a gonorrhœa will produce either a gonorrhœa, or a chancre, or the constitutional affections of syphilis—and that the matter from a chancre will indifferently give rise to either of these venereal affections. Hunter rested his belief and his doctrine mainly on an experiment on himself. He dipped a lancet in the venereal matter from a gonorrhœa. He made two punctures in the tissue of his own penis with the lancet so charged. One inoculation he made on the *glans*—the other on the *prepuce*. *Two* distinct results followed, *each of them marked by a distinct and specific period of incubation.* The inoculation on the PREPUCE was followed by itching from *the third to the fifth day.* On the fifth day the site of the puncture was red, thickened, and swollen. A speck became visible; and in a week this speck had commenced to suppurate; the urethra at the same time indicating the commencement of a discharge. The inoculation on the GLANS was followed by itching *fourteen days after the puncture was made:* three days later a speck appeared where the puncture had been made. The speck became a papule, then a pimple, and ultimately discharged yellow matter. The sore on the prepuce broke out several times after it healed up; but the sore on the glans never broke out again after it healed. The secondary lesions of syphilis followed this experiment, demonstrating the "infecting" nature of a virus with which he had been inoculated. Ulceration of the throat commenced in due time, and copper-coloured blotches on the skin followed in the usual sequence. The time the experiment took, from the first infection to the complete cure and elimination of the poison, was three years.

Now, with the knowledge of syphilis which we possess, can we say from which of these sores the constitutional disease arose? The answer will evolve itself in the sequel. Hunter believed he had inoculated the discharge of a specific gonorrhœa *only* and *alone;* but two important questions now suggest themselves, concerning which Hunter does not enlighten us, namely:—Had the person a concealed infecting chancre from whom Hunter took the virus? Was the patient suffering from constitutional syphilis at the time he had a gonorrhœa?

Besides Hunter, Carmichael in this country taught the same doctrine of a *single* virus; and Cazenave in France.

II. *The Period and Doctrine of Ricord.*—Ricord established, by numerous experiments repeated in various ways,—(1.) That the inoculation of gonorrhœal discharge by the skin is followed by no specific result; (2.) That *at least two,* if not *three,* distinct poisons exist—namely, *one virus* which would produce a gonorrhœa—another *virus* which would give rise to a specific ulceration, called a chancre. The ulceration of a chancre he observed to follow a very definite course. It commenced, as a rule, within twenty-four hours after the inoculation of the poison. A pustule formed, which breaking, a *soft* or suppurating chancre was the result. Ricord, however, eventually recognized *two* classes of chancres—the *soft* and the *hard;* but he described them as originating in the same way—by contagion from a similar primary sore. His experiments were of one or other of two kinds. Either they were made on persons who had been already affected by syphilis—now known to involve a most vital fallacy in drawing conclusions regarding the nature of syphilis; or on persons concerning whom it was not ascertained whether they had been infected with syphilis before or not.

Hunter showed that the secretion from *one* kind of syphilitic sore is not capable of being inoculated on the same body that produced it; and now we know that the discharge from the "*infecting*" sore cannot be inoculated on the already infected person. Ricord has further shown that the *plastic lymph*, the increased growth of tissue round a true chancre—the *specific sclerosis* or induration—does not take place a second time on the same subject; while Sigmund and many other observers are now agreed that the "infecting" disease does not repeat itself. This brings us to—

III. *The Present Period in the History of Syphilis.*—Its commencement is of very recent date—since 1856; and is characterized by a belief in the *duality* of the venereal virus exclusive of gonorrhœa.

The surgeons of Lyons—Rollet, Diday, and Viennois—Mr. Henry Lee, of the Lock Hospital, and Mr. Henry Thompson, of University College Hospital in London, Hubbenet, of the Syphilitic Clinique at Leipsic, Sigmund, of Vienna, and Von Bärensprung, of Berlin, are those who, by experiment and careful observation, have thrown most light on this remarkable disease. In addition to the specific virus of gonorrhœa (which may now be eliminated as distinct from those about to be noticed), these observers recognize two forms of venereal disease, distinct *in their origin, propagation, and development.* They recognize specific differences in the mode of development, and in the sequence of phenomena which distinguish an "infecting" and a "non-infecting" sore. They have shown that the sore which eventually *contaminates* the system commences differently from the sore which does not infect the system. The "infecting" sore (the one which contaminates) commences as a papule, pimple, abrasion, fissure, or crack, around which a specific growth of tissue takes place—a *sclerosis* or *induration.* A pustule is no essential part of the process, nor is suppuration. They are accidental phenomena, the result of irritation, pressure, or laceration, which produces a sore or ulceration—a result always very easily established and maintained in connection with infecting sores, as compared with other sores.

In women, compared with men, the open sore is said to be still more rare as the form of "infecting" sore. A hard chancre or sore in them is exceptional; and when it does occur, it remains small, is ill-developed, and is readily overlooked, even when

I have seen Chancres in women on labia majora one just within vagina one on thigh outside labia,

searched for with great care, aided by a vaginal examination with the speculum. In them the primary lesion which *infects* the system is always a papule (SIGMUND, CLERK). Another peculiarity connected with the "*infecting*" sore in women is, that such papules are apt to form along the course of the superficial lymphatics; and Ricord admits that induration is generally absent or ill-developed in primary sores in the vagina.

When the papule opens and becomes a sore, the fluid discharged from its open surface has been shown by Hubbenet, Lee, and Rollet to furnish a diagnostic test of the kind of disease, and of the sore from which it proceeds. Sigmund does not go so far as this. He does not consider the sores or chancres so different in form or character as to be at once distinguishable the one from the other. *He waits to see the virus produce* PART *of its effect* upon the system beyond the site of inoculation before he decides as to the nature of the sore. He waits to see the lymphatics indurate. He believes that then, and not till then, the distinction can be absolutely drawn between a sore which will infect the system and one which will not. He believes—(1.) That if induration of the lymphatics does *not* take place within six or eight weeks, and (2.) That if repeated successful auto-inoculations can be made on the bearer of the chancre during this period, then it is certain that the sore will not infect the system. If, on the contrary, the lymphatics indurate, and auto-inoculations cannot be then effected, the sore is assuredly an "infecting" chancre.

NB

The addition to our means of diagnosis from the nature of the discharge—pus from the one, not from the other—is one of great value when it can be made, because the diagnosis as to the probability of subsequent infection may in some cases be made earlier.

Period of Incubation.—The time of the commencement of a sore or lesion after inoculation or contagion is of great importance to be noticed. A definite period of incubation exists for the "infecting" sore, fixed by experiment as well as by casual observation. Diday and Rollet fix the period at twenty-four days if the poison is from a primary sore; but at twenty-six days if the poison is from a secondary lesion. Sigmund, of Vienna, fixes the period of incubation at from fourteen to twenty-one days. Sometimes it may be longer, but never beyond six weeks

Incubn 14 – 42 days
Induran begins 10 – 12 days after 1st sore

or forty-two days. The circumstances which may protract the period thus long are exhausting fevers, pregnancy, and anæmic states of the constitution.

Contamination of the System.—The "infecting" sore does not remain merely a local disease. It contaminates the system, giving rise by zymosis or multiplication to one of the most malignant, and most lasting, and most destructive forms of a poison disease that affects the human frame. How is this brought about? The only constant index of such contamination or secondary disease commencing, seems to be the occurrence of multiple enlargement of related lymphatics and lymphatic glands, which begins about ten or twelve days after the papule, ulcer, or chancre has made its appearance; or from four, five, or six weeks after contagion, or inoculation by sexual intercourse, or otherwise. This, too, may be delayed by exhausting diseases till three months after contagion. N3 Such glands do not suppurate. They enlarge slowly, and without pain in the immediate vicinity of the sore; and eventually those in the axilla become similarly affected, and ultimately enlargement of the chain of glands extending up towards the occiput, behind the sterno-mastoid muscle, is apparent. A general morbid condition of the whole system is the necessary result of this extensive disease of the lymphatic glands. Nutrition becomes defective. The blood is changed; it becomes anæmic. Emaciation is then often rapid. The digestive organs are impaired in function. The muscles lose their hardness, elasticity, and energy; and the lesions peculiar to syphilis set in.

The following table exhibits a scheme of the periods of appearance of the phenomena after inoculation from an infecting sore, and estimated from the first appearance of the papule or sore (SIGMUND):—

	Day—*9th*	*10th*	*14th*	*17th*	*19th*	*21st*
I. INDURATION OF SORE,.................................Cases	71	84	76	15	12	3

	Week—*4th*	*5th*	*6th*	*7th*	*8th*	*9th*	*10th*	*11th*	*12th*
II. ENLARGEMENT OF GLANDS,............Cases	31	44	56	74	46	20	13	9	—
III. SPOTS ON THE SKIN,.................. ,,	—	2	41	68	45	22	11	—	2
IV. PAPULÆ AND PUSTULES,.............. ,,	—	—	—	3	10	11	24	27	31
V. AFFECTIONS OF FAUCES,............. ,,	—	—	—	7	22	34	41	41	42

Cutaneous Affections.—Besides the general involvement of the glands, the condition of the skin may further demonstrate the contamination of the system. In the more insidious form of contamination its colour generally is altered. It becomes pale, white, The erupns of syph simulate every kind of skin disease, but here occupy different seats to the true affns (e.g.) lepra seizes parts not the knees & elbows -

fawn, yellow, or brown; and is wrinkled, dry, harsh, rough, and hard, and no longer soft and elastic. The eruptions are papular, pustular, or scaly, and they are peculiar in their symmetry of distribution, and in the curvilinear character of their grouping. They leave behind them stains of colour, pale cicatrices, or persistent ulcerations of the true skin. The local distribution of the syphilitic eruptions are also peculiar (DEVERGIE). "Their seats of election in the order of frequency are,—(1.) The parts round the alæ of the nose and the angles of the mouth; (2.) The roots of the hair at the forehead and back of the neck; (3.) The inner angle of the eyes; (4.) The centre of the breast; (5.) The inner side of the limbs, the neighbourhood of the axilla and the groins.

The Affections of the Fauces are often not more than a peculiar colour of the mucous membrane, persistent, however, like the staining of the skin (GAIRDNER), and eventually leading to disorganization. In women the process may cease with a slight follicular swelling of the mucous membrane of the fauces, tonsils, and soft palate (SIGMUND). If the process does not cease, then superficial erosions or deep ulcers of the soft palate supervene. Or still more diffused forms of ulceration may set in, involving great destruction of parts, and spreading in all directions—encroaching on the nasal fossæ and pharynx, eating away the epiglottis, extending down the air-passages, and even causing necrosis and exfoliation of the cartilages of the larynx.

Second Attacks of Syphilis.—The general infection is of such a kind as to render the system, as a rule, proof against a second invasion of the specific "*infecting*" virus. The disease never repeats itself, except, it may be, after a long interval. Sigmund has seen such a case. In this respect it resembles other virulent diseases acknowledging a specific virus as their origin; and in them the immunity is usually, but not invariably, complete—*e. g.*, small-pox, cow-pox, scarlet fever, and the like. After the system is once infected, the specific sore cannot be transplanted by contagion or inoculation to any other part of the body. The "*infecting*" sore is not *auto-inoculable;* and a person suffering from a chancre infecting his system will not be affected by a further inoculation of the same specific virus. There is, however, a slight qualification to be made here. Mr. Henry Lee has shown that (1.) There is a *stage* in the existence of an "*infecting*" sore when it is *auto-inoculable.* That period or stage is a very early one in the existence of the sore—namely, before any specific systemic action has begun to develop. If at this period the poison of another "*infecting*" chancre from another person, or from the chancre already existing on the same person, be inoculated, then a second "*infecting*" chancre, accurately representing the original, will result. The period when this event can happen is *before* the gland induration. (2.) Mr. Lee has shown that there is a *certain condition* of the chancre in which, at any stage, on being inoculated or transplanted, it will produce a sore. It then appears to be auto-inoculable. But this is only in appearance, and not in reality. The condition of the chancre that does this is one of *irritation.* Blister a chancre, or irritate it by an irritating ointment, or by any other means, so as to cause pus to flow—free pus-corpuscles being generated—and then we may have what has been recently termed a "mixed chancre," of much more frequent occurrence than has generally been supposed (SIGMUND). Sigmund has produced such chancres by inoculation. The utmost caution, therefore, is necessary before pronouncing a sore to be *non-syphilitic*—i. e., "*non-infecting.*" Sigmund inoculated the pus of a soft, contagious, or suppurating sore upon the infiltration or sclerosis of a hard papule on which the skin had remained unbroken. Between twenty-four and forty-eight hours after, a suppurating ulcer was established, which afterwards assumed Hunterian characters. Inoculation of two poisons may thus be in some cases simultaneous or successive. Hence "mixed chancres" present two aspects: on the surface is the soft, contagious, pus-producing ulcer; while deeper down is the specific syphilitic infiltration of the true "*infecting*" virus. Local plugging and enlargement of the superficial absorbents take place from such "mixed chancres," followed by similar infiltration of the group of lymphatic glands nearest to the sore, spreading gradually to distant and more distant groups. This is the constant series of phenomena after syphilitic "infection,"—a regular series of connected events, giving rise to such symptoms as are associated with no other disease poison except that due to syphilis.

In many cases of sloughing phagedena the syphilitic poison at once induces slough, as is the case with the poison of snake bites, already referred to at page 712, when the tissue and the virus both die simultaneously. Such cases do not, as a rule, infect

So, also, if the part inoculated is made to slough by escharotics, both the virus and the tissue may be destroyed; and herein lies the value of the early use of caustic sufficiently powerful to destroy the inoculated part.

On the other hand, the sore which does not infect, and which does not contaminate, is the "soft," suppurating sore—the "chancroid ulcer," as it has been called—or "the simple contagious ulcer of the genitals." The virus begins to act from the very moment of its application, and, after the formation of a pustule, ulceration is generally established by the sixth or eighth day from the time of infection. It is purely a local disease, and is generally very soon accompanied by an enlargement of the lymphatic glands, which goes on to suppuration, and ends there. This sore may be transferred or transplanted at will, by contagion or inoculation, from one part of the body of the patient to another, or from one person to another. It is thus auto-inoculable, and is always so, the period of incubation being short—about twenty-four hours only. Its virus is particularly irritating. Hence numerous sores of this nature may exist on a person at one and the same time; but *successive infecting sores* do not, as a rule, ever exist on the same person. The *multiple* character of the simple sore is now generally recognized, and likewise the *solitary* character of the infecting one. The soft chancre is altogether a local sore, and so remains; while thousands of them may be multiplied at will successively over the same person's body, especially during its stage of suppuration and ulceration. The ordinary site of the soft chancre is on the *prepuce*, and in the sulcus behind the *corona glandis.* The parts most susceptible of laceration are the parts most exposed to the inoculation, and where the virus is most likely to nestle and to be overlooked (MILLER).

[illegible] etc ?
Soft chancre

As far back as 1856, Mr. Lee showed, and Mr. Rollet since then has also shown, that not only is the infecting sore not capable of being transmitted from one part of the body to another, but it is not inoculable upon a person who has been already contaminated by syphilis, more particularly so long as lesions continue to develop themselves. It is, therefore, as necessary now to distinguish "infecting" and "non-infecting" sores as it is necessary to distinguish the various forms of continued fevers.

In future experiments and observations as to the effects of primary syphilis, it must be remembered that the subject cannot be studied or experimented with, to any extent, upon the patient himself. For this reason many of the early observations of Hunter and Ricord are limited and fallacious: one might as well attempt to study the vaccine disease by re-inoculation of it on the same person a second time, immediately after it has produced its specific effects. *

3. **Vehicles or Media by which the Specific "Infecting" Virus may be Inoculated.**—Besides the discharge (non-purulent or mixed) from an infecting sore, there are at least three other sources of infection, namely,—(1.) The contagion of secondary syphilitic sores —*e. g.*, the syphilitic secondary ulceration of the female nipple, inoculating the mouth of the healthy infant born of healthy parents. (2.) It is now also established that *secondary* syphilitic inoculation (*e. g.*, the discharge from the softening and ulceration of gummatous tumors, mucous tubercles, papules, and the like)

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* Another kind of sore very frequently seen about the *prepuce* or *glans penis* of men, or the *vulva* of women, is mentioned here to guard against its being confounded with soft venereal sores, or with chancres—I mean the sore which forms after the eruption of *Herpes preputialis.* The eruption of *Herpes preputialis* commences by itching, which is felt at the base of the *glans*, at the internal surface of the *prepuce*, or at the junction of the *prepuce* and the *glans*. This itching is often so slight as not to attract notice, and it is not of the same kind, nor does it occupy the same site, as the itching of gonorrhœa. The surface of the *glans* or of the *prepuce* may be red, and although nothing may be at first visible with the naked eye, yet by means of a hand lens small circular elevations of cuticle are to be seen, raised by limpid serum. Several groups of these small vesicles generally occur, separated from each other by the space of a few lines. These eventually burst, and in their place small circular ulcerations, perfectly distinct, are to be seen, with a red bottom, and measuring scarcely a quarter of a line in diameter. The site of these herpetic ulcers is highly sensitive, and secretes pus and fluid, usually of an offensive and peculiar odour.

When the groups of vesicles are situated on the *cutaneous* surface of the prepuce, they are but slightly inflamed, compared with those situated on its internal or mucous surface. Frequently the fluid contained in the vesicles on the cutaneous surface is re-absorbed, when slight desquamation ensues over the lesion. If the fluid is not absorbed, it becomes opaque after a few days, and small scaly incrustations take the place of the group of vesicles. The disease may thus terminate in about *seven* or *eight* days.

When the groups of vesicles form on the internal aspect of the prepuce, they increase in size rapidly, and the inflammation is much more active. The walls of the vesicles are so extremely thin and transparent that the red colour of the inflamed tissue may be seen through them. But the fluid soon becomes opaque and sero-purulent, small moist crusts or scabs form, which, being detached naturally or accidentally, expose excoriated spots; and it is important to distinguish these from soft venereal chancres. The venereal sores never commence as vesicles.

gives rise to a sore which exactly resembles a primary infecting chancre (Lee, Rollet, Viennois). But it is said to differ in the following particulars, namely,—(*a.*) The period of incubation is said to be somewhat longer; (*b.*) Ulceration is superficial; (*c.*) The sore heals in a shorter time; (*d.*) Induration is less marked; (*e.*) The constitutional infection is longer in developing itself; and (*f.*) The lesions which result are said to be not again contagious. Thus it is supposed the great epidemic of the fifteenth century gradually abated. Hence also, perhaps, the modern belief in the modifying influence of syphilization may to some extent be explained—an operation which is not warranted by the present scientific knowledge we possess. (3.) The blood of those suffering from acute secondary syphilis inoculates. (4.) A female, otherwise free of syphilis, may become contaminated during the gestation of a fœtus begotten of a male who, at the time of the fruitful connection, was himself alone suffering from contamination of the system by syphilis, in some form of active secondary phenomena (Diday, Maclean). In such cases no syphilitic sores existed on the genital organs of either party at the period of sexual intercourse.

Experiments at Florence, at the Clinique for venereal diseases, show that healthy persons may be inoculated with the blood of syphilitic patients. It is related that, on January 23, 1860, two young doctors were inoculated with the blood of a syphilitic patient, but no result followed ; on February 6, 1862, three other doctors (perfectly free from syphilis) were inoculated by venous blood taken from a female suffering from the acute lesions of secondary syphilitic disease. Charpie soaked in the blood was applied to an abrasion in the arm of each. On March 3 (twenty-five days after the operation) in one of them a slight itching and elevation was perceptible, a papule formed, which, eight days afterwards, became covered with a crust. This crust increased in thickness day by day, and twelve days after the appearance of the papule two glands in the axilla became enlarged, and the sensibility of the papule increased. Nineteen days after its appearance the crust fell off, leaving a funnel-shaped chancre, with elastic resistant borders. On the twenty-third day the chancre had increased in size and induration. On the fortieth day eruption on the skin and glandular swellings in the neck supervened. The erythema lasted eight days, and pursued a regular course.

On the forty-eighth day the glands had increased in size and hardness, the chancre maintaining its specific condition, showing no tendency to heal.

On the fiftieth day the colour of the erythema became decidedly coppery, and treatment by mercury was then begun. In these experiments the blood communicated disease to *one* out of *five* who submitted to the experiment. The recognition of this fact explains many occasional cases of syphilitic affection hitherto obscure—*e. g.*, syphilis from vaccination, contamination of a healthy nurse from the sore mouth of an infected infant, and the like. One of the most remarkable and lamentable instances of the inoculation of syphilis through vaccination is that which is now well known as the epidemic at Rivalta. At that place no fewer than *forty-six* children became affected with syphilis, the disease being communicated to each of them through the operation for vaccination (PACHIOLLI, SPERINO, *New Syden. Society Year-Book*, 1861-62).

4. **Morbid Anatomy of the Secondary Lesions and Local Growths in the Internal Viscera.**—These are now so uniformly found associated with a history of syphilis that they are rightly regarded as the remote effects of the specific venereal or syphilitic virus. So varied are the effects of syphilis that a complete account of syphilis and its lesions has yet to be written; but it may be useful to illustrate some of the points of view from which the subject in its pathological bearings is now being examined, premising that it is necessary to *examine* the subject carefully from year to year, as opportunity offers and as fresh facts add to our knowledge, being ever alive to the fallacies which inevitably surround the most patient investigations.

From any one of the sources of infection already noticed, the later stages of syphilis are characterized by lesions which are distinguished from the earlier specific affections, both by their situation and by their morbid anatomical peculiarities.

Differences in the stage of the disease have hitherto been mainly based upon the organs affected. The *primary affection* being local, the so-called *secondary affections* or *stages* were considered to be those which involved the skin, the mucous membranes, and the iris; while the *tertiary symptoms* or *stages* were those which implicated the areolar tissue, the bones, the muscles, the liver, the brain, the heart, lungs, and the kidneys.

A division based on the *anatomical* characters of the lesions seems to be more satisfactory than any arbitrary arrangement into stages of a supposed primary, secondary, or tertiary order (HALDANE).

1. In the so-called primary and secondary affections we have mainly to do with congestions, inflammations, and ulcers.

2. In the tertiary lesions and advanced stages of syphilis there is—(*a.*) A "constitutional cachexia," with certain definite anatomical characters; and (*b.*) A tendency to the growth of a peculiar material, chiefly in the form of gummatous tumors or nodules, of which the *node* is the common and familiar type; but which are found not only in the bones, but in the areolar tissue, the liver, the lungs, the heart, the brain, the muscles, the testicles, the eye. (*c.*) There is likewise to be observed a tendency to various interstitial inflammations; and (*d.*) The occurrence of cicatrix-like losses of substance visible on the surface of solid organs.

With regard to the "constitutional cachexia," it is necessary, if possible, to distinguish the degenerate nutrition brought about by "inherited" syphilis, as contrasted with that brought about by acquired syphilis.

The constitution of the person also materially influences the phenomena which supervene during syphilis—*e.g.*, gout, rheumatism, tuberculosis, and cancer modify the syphilitic lesions and degenerations; while constitutional syphilis in its turn modifies the character of ordinary diseases.

Persons with a tendency to rheumatism are apt to have the same tissues involved in syphilitic lesions as if they suffered from rheumatic inflammation. Hence syphilis is often set down as a cause of rheumatism. The serous, fibro-serous, white connective tissues are the sites of the lesion in the forms of *periostitis, iritis, corneitis*, and affections of the true skin.

In tuberculous patients those tissues are apt to be involved in the syphilitic lesions which are most prone to ulcerate, and to have tubercles grow in them. Hence syphilis is often set down as a cause of phthisis. The mucous membranes are most prone to suffer in such cases. Hence syphilitic growths develop themselves in the lungs, the glands and brain, pharynx, larynx, tonsils, tongue, and testicles.

In the gouty or vascular subjects the arterial or vascular structures and joints are apt to suffer most from the syphilitic virus, and the lesions are chiefly in the form of degenerations. Hence syphilis may be set down as a cause of disease in the great blood-vessels, leading to thoracic and abdominal aneurisms at an early period of life; and of the smaller blood-vessels, leading to *amyloid degeneration*, or waxy degeneration of the liver, kidney, spleen, and intestines.

The lesions in syphilis eventually assume a variety of anatomical forms, but in the first instance they are to be recognized in the typical forms of *nodes*, *gummata*, *tubercles*, or *knots*, as *periostitis* and *inflammations of fibrous tissues*, tending to *caries*, *necrosis*, or *abscess*, or to *hypertrophy*, as in *exostosis*, and ultimately to cicatrices in various organs. Secondly, in degenerations, such as the amyloid. (See page 120.)

Gummata are the characteristic lesions of tertiary syphilis. They form growths which lead to the development of elastic tumors, composed of a well-defined tissue, but with elements extremely minute. The gummatous tumor takes origin from the elements of connective tissue, or the analogues of such tissue, and hence the universality of the site of these lesions. They are like pus or an abscess in this respect.

NB

When they first attract attention (as a node on the skin, or on the shin) they are small, solid, pale swellings, like a hard kernel, varying in size from that of a pea to the size of a haricot bean. They may be generally first seen in true skin, or subcutaneous or submucous tissue; and where the tissue is lax they grow to a considerable size, and give a sensation to the hand as if filled with gum. Repeated examinations of this growth show that in the gelatinous condition it arises from a proliferation of nuclei in the cells of the connective tissue—like the formation of granulations in a wound. The component cells appear as round, oval, or oat-shaped particles, imbedded in a matrix of fine connective tissue, of a granular character, tending to fibrillation. The cells are a little larger than blood-globules, and contain granules in their interior when mature. In the young condition they are contained, and are seen to grow in groups, within the connective tissue corpuscles. In some respects they resemble tubercle, but differ thus in the mode of growth. How, then, do we recognize the nature of such growths? First, taking the history of the case as a guide, we are led to conclude entirely from the anatomical character of the growth; and when such lesions are seen in a case with a distinct history of syphilis, several questions suggest themselves for consideration. Is it the result of inflammation? Is it cancer or tubercle? Is it a syphilitic lesion? Are there traces of other similar lesions in the body? As a rule, *inflammation* leads to abscesses or hypertrophies of tissue or fibroid degeneration, and round all these syphilitic nodes we have such hypertrophy and degeneration, just as we have round tubercle nodules. Abscesses are easily recognized by the pus; and which, being altered by age, may still be anatomically recognized. *Cancerous* masses are recognized by the juice expressed from them. Here we have no juice; and the cell-elements seen in cancer are characterized by the diversity of their form and growth. Here the elements are uniform in appearance and size, and form growths less highly organized than cancers, which tend to infiltrate and involve neighbouring textures; whereas the gummy syphilitic node remains isolated, and is usually surrounded by a dense but clear, semi-transparent, greyish, vascular, fibrous tissue, and very resistant to the finger. Thus these nodes appear sometimes as if enclosed in a kind of cyst, from which they may sometimes be enucleated. Tubercle always destroys vessels in its centre — syph. gummata not —

By way of elimination or exclusion, therefore, we may thus come to recognize such growths as syphilitic—even without a history of syphilis (HALDANE). They have been recognized now and described in all the solid viscera of the body. The microscope has enabled us to study them with minuteness; but it is only their history, position, mode of appearance, structural elements, cause, and results, which enable us to recognize their true character.

Development and Course of the Syphilitic Node.—(1.) Proliferation goes on, and a glue-like mucous fluid forms, constituting the inter-cell material. The tumor, if near the surface, melts, opens, and ulcerates, thereby giving evidence of active or acute constitutional disease. (2.) The tumor continues gelatinous and coherent (if in dense parts, deeply seated), as in gummata of the periosteum, scalp, brain, liver, lungs, and heart; thus giving evidence of constitutional disease, latent or inactive. (3.) Having arrived at a more or less complete degree of development, they may undergo a retrograde or fatty degeneration, which may eventually lead to its absorption; and this is a natural or spontaneous process of cure; but traces of the existence of such nodes may be left in the form of cystoid membranes, as in the brain; or of fibrous bands, or cicatrix-like loss of substance, as in the liver. In some instances the nodes undergo calcareous degeneration.

In the Bones these syphilitic lesions arrange themselves in *two* groups:—

1. The primary characteristic growths, or various states of gummata or nodes, which advance to the formation of ulcers; and the death of parts in little necrotic sloughs or cores of dead bone, imprisoned within circles of bone. There are usually several points of attack; and numerous holes or pores, with furrows converging to the centre, where the lesions first commence, giving rise to characteristic stellate depressions. Caries and necrosis of the bone follow the eating ulcers of soft parts, such as the roof of the palate, the nasal septum, the laryngeal cartilages; or caries and necrosis may follow periostitis of the long bones. Internal caries and necrosis may also occur, beginning in the marrow of the bone, giving rise to suppurating osteo-myelitis. Most of these forms of syphilitic lesions are to be seen in the skull bones, especially in the forehead and anterior parts of the skull. They may be seen as superficial or deep exfoliations of the outer laminæ. The deeper portions become dead in small circles, enclosed by new bone; or existing like the core of a carbuncle, they cannot be removed without enlarging the aperture through which they make known their existence. The cicatrices which result after absorption or elimination of gummata in bone have a characteristic appearance, especially denoted by the want of growth in the centre, and activity of growth at the edges after loss of substance.

2. The virus of syphilis seems to have the power of fostering the growth of simple interstitial inflammatory products, and thus leading to *hyperostosis, exostosis,* and *hard nodes.*

In the Skin there are two groups of syphilitic lesions to be recognized,—(1.) Local growths, which generally assume the form of eruptions; (2.) Cicatrices. The local growths occur in the superficial layer of the corion (VIRCHOW, BÄRENSPRUNG); and ultimately tend to grow deeper, and to affect more permanently the derma and subcutaneous tissue (A. T. THOMSON).

When such growths soften (as they tend to do when superficial), great destruction of tissue is the result. The cicatrices which follow are permanent and unseemly, and may ensue without any abrasion of surface. This is especially the case in papular and tubercular forms of syphilitic skin diseases. The growth is generally associated with effusion of fluid, which causes the hardness; absorption taking place, atrophy of tissue follows; there is a falling in of textures, accompanied by obliteration of blood-vessels, and resulting in an unseemly white scar.

The diagnosis of syphilitic eruptions may in general be arrived at,—(1.) *From the history of the case.* A chancre commencing at least two weeks after exposure to contagion, becoming indurated, and followed within six or eight weeks by induration of the lymphatic glands. (2.) *From the symptoms accompanying the eruption.* A dusky tint of the skin, rheumatic pains in the head and joints, *alopecia,* ulceration of the throat, *iritis,* nodes, *gummata,* disease of the testicle. (3.) *From the eruption appearing in several forms at one time on the body—e. g.,* Condylomatous, roseolous, lichenous. (4.) *From the general coppery tint of the eruption.* Strumous inflammations have a dusky red or vinous tint, simple inflammations in a healthy person have a bright red tint, but syphilitic eruptions in the chronic stage have a characteristic coppery colour. (5.) As a rule, there is *an absence of itching in* syphilitic eruptions. (6.) *Syphilitic eruptions tend to assume a more or less circular form.* (7.) When the eruptions of syphilis ulcerate, *the ulcers are generally round,* with *perpendicular edges and unhealthy bases. More* than one of these characters must guide the diagnosis, and not one only.

Affections of the Nails occur in two forms, namely,—(1.) As *onychia;* and (2.) As a dark-red eruption on the nail, due to congestion of the vascular layer beneath, with numbness, and tingling beneath the surface. The nail atrophies, desquamation from its surface commences, and continues with splitting up of the substance, and pitting. Lastly, the nail crumbles down from the edges and free margin, point, or tip. It is irregular, and thickened from the under part (Psoriasis of the nail), analogous to the "Seedy toe" of horses, (Compare Richardson's very interesting paper in *Clinical Essays,* vol. i.)

In the Substance of the Heart Virchow describes the syphilitic growth, and refers to cases of a similar kind recorded by Ricord and Lebert. Ricord, in his atlas, gives illustrations of them, and calls them "Syphilitic muscular nodes in the substance of the heart" (*Clinique Iconographique*). Firm, yellow, cheese-like masses were found in the substance of the ventricles. There was a history of old chancres and ulcerated tubercles of the skin.

In Lebert's case these gummata were seen at a comparatively early stage of development, and were found in the wall of the right ventricle. There were tubercles of the skin, of the subcutaneous tissue, genital organs, and bones of the skull (*Anat. Pathologique*). In Virchow's case there were syphilitic gummata in the testicles.

Dr. Haldane records a case of a similar kind, and gives excellent drawings in *Edin. Monthly Med. Journal* for Nov., 1862.

In the Museum of the Army Medical Department at Netley there are two preparations which show such gummata in the substance of the heart. One occurred in the case of a soldier, twenty-four years of age, under treatment for venereal ulcers of nine months' duration, on various parts of the body. He had lost his palate, and eventually sunk from exhaustion, with symptoms of phthisis. Sections of the muscular substance of the heart showed several isolated deposits in its substance and beneath its serous covering; and isolated portions of the lungs were converted into a substance of the consistence of cheese.

In the Brain such gummatous tumors have been especially described by Bonet, Ricord, Cullerier, and Lallemand. Ricord describes them under the name of the syphilitic tubercle of the brain. Dr. Steenberg (physician for the insane at Schleswig) believes that a great proportion of the syphilitic affections of the brain are subsequent to lesions of the arteries; and the organs of circulation generally he observes to be the frequent seat of syphilitic localizations. Hence softening of the cerebral substance, and various lesions of the nervous system, are by no means rare in cases of prolonged syphilis; and Virchow has frequently noticed lesions of the great vessels in those who die from syphilis with lesions in the brain. The tendency to aneurismal dilatations and cicatricial-like loss of substance in the lining membrane of the great vessels, in young subjects who are severely affected with syphilis, is a subject in morbid anatomy which requires yet to be investigated.

In the cases where cerebral symptoms have long co-existed with syphilis, "a quantity of tough, yellow, fibrous tissue unites together the surface of the brain with the adjacent membrane, and this again is adherent to the bone. The cortical substance of the brain at the affected spot is often partly destroyed, and the adventitious material occupies its place. The question has still to be solved as to what structure is primarily affected. Many have given the authority of their name to the opinion that the disease commences first in the bone, but simply for the reason that the osseous system is that which has so long been recognized as liable to be affected. But since we now know that other structures may be similarly attacked, we are prepared to look for its commencement in other parts, and even in the brain-structure itself. . . . The cases which are so frequently met with are those where the deposit involves both sides of the *dura mater*, and includes in it the bone on one side and the brain on the other. The probabilities are in favour of its occurring in the *dura mater* first, as it arises in the periosteum on the exterior of the cranium" (Wilks in *Med. Times and Gazette*, Oct. 25, 1862).

But the lesion also occurs in isolated gummatous nodules in the great nervous centres, such as the *thalami optici* or *corpora striata*. I saw very recently (29th May, 1863) a most interesting dissection of such a case in the Middlesex Hospital, which had been under the care of Dr. Goodfellow. There had been a history of syphilis, and some of the children of the man had died of inherited secondary syphilitic lesions. A gummatous tumor occupied the left *optic thalamus*. Numerous cases of syphilitic tumor of the nerves and nervous centres are to be found collected together in the pages of the *Medical Times and Gazette*, and two may be referred to of the intra-cranial nerves, related in the 17th vol., for 1858, p. 419, in each of which paralysis was due to such syphilitic *neuromata*.

The lesions of encephalic syphilis are ushered in by obscure phenomena; but the following may be especially noticed:—*Insomnia* manifests itself at the commencement; and *headache* is characterized by—(1.) Violence; (2.) Prolonged duration; (3.) Nocturnal recurrence or exacerbation. The *general nervous symptoms* are especially obvious in alteration of intelligence, of sensibility, and of motion. These, combined with such obvious local lesions as caries, or necrosis of the facial bones or of the cranium; or tumors on the external surface of the cranium, such as gummata, periostitis, or exostosis, at once point to cerebral syphilitic lesions; which are sometimes expressed by persistent epilepsy.

Any form of syphilitic infection may be followed by nervous affections, from a year old up to old age. Syphilitic brain-disease generally leads to *softening* of cerebral substance surrounding the nodule; and this softening cannot be distinguished from the softening induced by any other cause. The duration of syphilitic nervous affections averages about one year; and their natural course is characterized by intermissions; and at the outset the intermissions are very distinctly expressed.

A point in the pathology of syphilis at present assuming considerable importance, is the influence which an open suppurating sore of a secondary or tertiary kind has in removing the tendency to the localizations of lesions elsewhere, and especially in internal parts. Dr. Steenberg says, with reference to cerebral lesions, that he has seen the existence of an ulcer of a tertiary kind act as a natural issue in subduing the irritation of cerebral lesions, an entire remission of the nervous symptoms occurring while the ulcer remained open. Hence the great benefit which often follows the use of a seton in syphilitic epilepsy.

Mr. Henry Lee also writes that "fresh inoculations from suppurating sores during the time of their development check the activity of other lesions of the skin;" and, no doubt, of lesions elsewhere. Hence the reputed good effects of the filthy process of syphilization may in some degree be explained by these facts, as in cases where syphilization has been continued during several or many months.

The syphilitic lesions capable of affecting directly or indirectly the sense of sight are numerous and various. These involve either the optic nerve itself or the constituent parts of the eye—e. g., *choroiditis;* diffuse exudation throughout the *retina;* atrophy of the *optic nerve* and its *papilla,* with diminution in the calibre of the central vessel; circumscribed abscesses, or partial softenings developed in the course of the optic nerve (VON GRAEFE).

Syphilitic Lesions in the Lungs have been long ago described by Morton, Sauvage, Portal, Morgagni, and more recently by Graves, Stokes, Walshe, Wilks, Virchow, Ricord, and Munk.

Two forms of syphilitic lesions of the lungs are recognizable,—(1.) *Bronchitis,* or bronchial irritation at least, with fever, in many cases precedes the skin lesions, and disappears wholly or partially when this is established; and if the syphilitic eruption suddenly disappears, bronchitis may again ensue (WALSHE). The

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patient may thus have all the symptoms of phthisis, yet no tubercle existing in the lung. The tendency of syphilis is thus to induce phthisis in those especially constitutionally predisposed, and where mercury has been taken. Periostitic thickening of the clavicle and the upper ribs is apt to lead to the belief that tubercle is present, on account of the consolidation. Care is necessary in the case of young soldiers, who, having been just discharged from hospital, after the cure of an infecting chancre, may be exposed to cold and wet on guard, and so have an attack of syphilitic bronchitis induced—the probable commencement of a growth of tubercles in the lungs, or of solitary syphilitic gummata (*Annual Report of Army Med. Depart.* for 1861). (2.) Deposit in the pulmonary substance, in the form of gummata, of the same histological constitution as the well-known subcutaneous product which has been described by M. Ricord and M'Carthy as forming in the lungs, especially towards their periphery and bases. Towards the periphery they are like nodules of lobular pneumonia. They soften, and are eliminated very much like tubercle, and have at first a consistence like scirrhus. They are non-vascular (WALSHE).

Syphilitic Lesions of the Liver.—Dittrich and Gubler were the first to give an accurate description of these syphilitic deposits in the liver. Virchow has also described a peri-hepatic lesion and a simple gummy interstitial hepatitis. The former never occurs alone, but is generally associated with the latter. The hepatic substance atrophies, and the deposit contracting, is eventually absorbed, causing a cicatrix-like mark. The liver lesions are usually among the later symptoms of syphilis, and are well described by Wedl, Virchow, Wilks, and Frerichs.

The Syphilitic Lesions of the Testicles have been minutely examined by Virchow and Wilks. Where the general substance of the testicle is affected the deposit is interstitial, and the free portion of testicle is first attacked; then the tunica albuginea thickens, and the inflammation extends along the tubes.

The middle cones of the testicle are most frequently affected, and they increase in size from proliferation of tissue-elements. The interstitial tissue softens and is red, the tubes thicken, fatty epithelium becomes developed, and atrophy results. Solitary nodules may sometimes form, varying in size from a millet-seed to a cherry. They look like yellow tubercle, and are analogous to the gummata observed in the scrotum and in the substance of the tongue, which are hard and elastic, about the size of a pea, and easily overlooked. These tumors in the testicles and tongue are peculiar, in not growing from a centre, like other tumors, but rather as infiltrations of tissue (WILKS). Thus they are not perfectly circumscribed, but are found mixed up with the adjacent tissues.

Lesions of the Tongue of a syphilitic nature are to be seen in many of these cases. They are mostly expressed by ulcerations at the base, often in such positions that the laryngoscope only can disclose them to view. Sometimes they appear as a raw, indolent, abraded-like surface, in circumscribed patches, on the dorsum or edge of the tongue—the aphthous exfoliation and syphilitic tubercles of Erasmus Wilson. (See Plate 3, fig. E, of his work *On Syphilis.*)

Hints for the Investigation and Description of Syphilitic Ulcers.—1. Ascertain as near as possible the date of contagion, keeping in view the media or vehicles of contagion, in addition to virus from a true primary chancre—namely, from ulcers in acute secondary syphilis; from the blood of patients suffering from acute secondary syphilis; from sexual intercourse, followed by conception, with a man who is at the time suffering from syphilis in some of its active secondary forms; from mixed chancres carrying the virus; from sloughing sores carrying the virus.

2. Examine the patient, keeping in view,—

(*a.*) That the soft, "non-infecting" sore commences almost immediately (*i. e.*, twenty-four hours to within three days after connection). It commences as a red spot, or a point, passing very soon into a pustule and a soft suppurating sore.

(*b.*) That the "infecting" sore does not commence before the end of the second or beginning of the third week (eighteen to twenty-four days); and if the disease has been contracted from a secondary ulceration, not before the expiration of the third or fourth week (RINECKER). A specific sore results in the form of a papule, abrasion, fissure, or crack; the formation of pus, or an ulcer discharging pus, being an accidental occurrence.

3. Examine microscopically the discharge from all syphilitic sores, keeping in view—(1.) That a "soft, non-infecting" sore discharges pus-cells; (2.) That the fluid discharged from an "infecting" sore is not pus, but a molecular debris.

4. The irritation of an "infecting" sore may cause it to discharge pus along with the "infecting fluid." Hence "mixed chancres."

5. The soft, purulent, non-infecting sore may be transplanted at will, and at any time, on the patient's body. The true "infecting" sore cannot be multiplied after glandular enlargement and general infection becomes developed. It remains a solitary sore.

6. Look every day for cutaneous eruptions during the existence of a primary sore.

7. Examine the lymphatic glands—not only in the vicinity of the chancre, but also those in the axilla, and the neck up to the occiput. Note as to the slowness or rapidity of the enlargement—hardness or softness—tendency to suppuration, and whether painful or not.

8. From the account of syphilis and venereal sores which has been given in the preceding pages, it must appear clear that definite nomenclature must be adhered to in describing venereal or syphilitic sores.

Syphilization.—By this name an operation is now known which has for its object the eradication of syphilis from the system by repeated inoculations of the virus. Dr. Boeck, of Christiana, is the most persistent advocate of this mode of dealing with syphilitic cases as a remedy against constitutional affections.

It may be useful to explain here in detail the origin and doctrine of Syphilization, previous to considering the rational treatment of the disease.

In 1844 a young French physician—Auzias Turenne—commenced a series of experiments with the view of testing John Hunter's doctrines regarding the non-communicability of syphilis to the lower animals. He succeeded at length in producing, on monkeys inoculated with chancre matter, a disease which had all the characters of a chancre. A disease was communicated to them capable of being transferred to rabbits, cats, and horses. It appears, also, that syphilis was established in these animals; and the chancres produced by inoculation became less and less in each animal, until at length a period arrived at which the virus seemed to lose all its power. No sores of any kind occurred. When a sore was established, however, in these animals, the virus was preserved, and was capable of transmission, and of re-transmission back to man. It was inoculated from a cat upon Dr. de Welz, a German physician and Professor in the University of Wurtzburg. On him it gave rise to a hard chancre, then to constitutional syphilis, demonstrating that the virus lost none of its virulence by the transference from man to animals, and from animals back to man. Nevertheless, Turenne believed that by prolonged inoculation the system became protected.

Sperino, of Turin, next took up the question. He inoculated persons suffering from syphilis by virus from a chancre, and repeated the inoculations once or twice a week till the virus ceased to produce any effect; and when this point was reached, all other sores had healed. This naturally gave rise to the belief that, like vaccination, the system became protected; and to this process the name of Syphilization has been given.

When we consider the suffering, the long confinement, the filthy sores, and the innumerable cicatrices left, as well as the doubtful results, the uncertain state of our knowledge regarding the virus of syphilis, and the media of its conveyance, it cannot be conceded that we are warranted in sanctioning the method of treatment by syphilization. At Copenhagen, at Florence, at Turin, and other places where large hospitals exist, extensive experiments have been carried out in public; and although time and additional evidence are both wanted to learn ulterior results, nevertheless I think the facts are capable of a totally different explanation from that which has been given them, and to which I have adverted. But, let me go more into detail.

Sperino's cases and Lee's experience show that during the active existence of phagedenic suppurations and continuous suppurating sores, in a patient suffering from syphilis, the phenomena of secondary infection do not advance, but the symptoms of contamination gradually wear out. Moreover, suppurations are easily established on the syphilitic. The action set up in them by repeated inoculations—the so-called syphilization—is merely a continuous suppurative action: indurated sores are not produced. The system is already contaminated; and the infecting virus will not produce any additional specific effect. Lastly, syphilis, in course of time, tends to wear itself out of the constitution. Hence the *modus operandi* of so-called syphilization may be explained, conjointly—(1.) By lapse of time; (2.) By continuous suppurations affording a drain or source of depuration to the system; (3.) From simple non-specific ulceration being sufficient to accomplish this result, as shown by the fact that the experiments on syphilization have been effected from all forms of venereal sores, discharge having been taken indiscriminately from soft as well as true infecting chancres. Moreover, the experiments recently made by Dr. Lindwurm, of Munich, clearly prove that any curative influence which the so-called process of *syphilization* may possess is due to the excretory action of numerous and prolonged simple ulcerations. He submitted fourteen syphilitic patients to friction with tartar-emetic ointment, without any other treatment. When the pustules from one inunction had dried up, a fresh crop was produced by a second inunction in another place; and this was repeated. The results were, in some instances, surprisingly favourable, in others less good, and in others negative. He therefore justly considers that syphilization and tartar-emetic-ointment frictions produce like results (*New Syden. Society Year-Book*, 1860, p. 325).

The process to which the name of Syphilization has been given consists of the following details:—

(1.) Matter is taken from a sore—an indurated one by preference. (2.) A patient suffering with secondary syphilis is inoculated with it. (3.) From the pustules (*which form in about three days*) fresh inoculations are made. (4.) Every third or fourth day continue so to inoculate, always taking matter from the last pustule as long as it continues to give any result. (5.) When it ceases to give any result, new matter is to be sought for from another primary indurated ulcer, and continuous inoculation to be made as before on the sides of the person's body. (6.) When this ceases to take effect, new matter is again to be sought for and inoculated on the arms, and so on till no further inoculations will succeed. (7.) The operator is to go on inoculating so long as any new matter will produce a pustule. (8.) When no sores can be produced, the cure is considered complete; and all the symptoms of contamination from syphilis will then be found to have vanished. (9.) During this process the diet must be good and generous, no wines or spirits being allowed. The artificial ulcers are to be covered with wet cloths, and the utmost cleanliness is necessary. (10.) The mean time required to complete the cure is said to be four months (some say six months). The very length of time implies a fallacy, for by lapse of time alone the disease, in some constitutions, is known to wear itself out (GAIRDNER); but the belief in the virtue of syphilization appears to be based on a total misconception of the nature of the results obtained by the process, and on an erroneous interpretation of the facts which suggested the process. It is therefore of importance to note that the value of syphilization as a remedy may be expressed in the following summary:—

1. In the experiments on syphilization all forms of the venereal poisons have been indiscriminately used.

2. The action set up by the operation is merely a continuous suppurative action. It is not alleged that the repeated inoculations produce indurated sores. Indeed, it is proved that, once the system is contaminated, the infecting virus will not produce any specific effect so long as symptoms of syphilitic contamination continue.

3. Lee's cases, and such experiments as those of Dr. Lindwurm, show that if continuous suppuration is maintained, the phenomena of secondary infection do not advance, but tend to wear themselves out; and that suppurations are easily set up in those contaminated by syphilis.

4. The *modus operandi* of syphilization is therefore explained —(*a.*) By lapse of time; (*b.*) By continuous suppurations (simple), affording a drain or source of depuration to the system. X

Treatment of Syphilis.—As in the case of other *enthetic* diseases, it is clear that if the inoculation of the syphilitic virus could be recognized in time, the site of inoculation, and with it the virus, by being destroyed, subsequent infection of the system might be prevented. But experience shows we must not conclude that even by an early destruction of the sore the occurrence of constitutional infection will be always prevented. The exact nature of a sore cannot yet be recognized at a sufficiently early date (apart from all other means of diagnosis) as to whether it will or will not prove a sore carrying a virus which will infect the system. In cases where the sore is a suppurating one, *occurring late after* exposure to infection, such a sore may be of a mixed nature, and therefore is of doubtful character, and always suspicious.

The local progress of such sores may be arrested with escharotics, if they are applied at an early period of its existence, and before contamination of the system is evinced by induration of

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the base of the sore. Ricord and Sigmund have found that sores destroyed by the more powerful caustics, within *from three to five days*, have not been followed by syphilitic symptoms. But these may have been cases of soft chancre, which would not infect. The only efficient caustics for this purpose are—(1.) The *strong nitric acid;* or (2.) The *potassa cum calce* (most conveniently used in the form of small sticks). *Nitrate of silver* is useless, from its limited action and deficiency of penetration. If the sore threatens to slough, the parts should be wiped dry, and *nitric* acid applied, and afterwards a lotion of the *potassio-tartrate of iron*, while the same drug is given internally. *Chloride of zinc* paste (FELL'S) is a useful escharotic to excite a healthy action round the periphery of a sore. If great pain attends the local progress of the chancre, *morphia* in *liquor ammonia acetatis* is highly beneficial.

Mercury, administered during a primary sore, seems to be one of those agents which are able to break the regular order of the manifestation of symptoms, as it does to several other diseases; although it may not seem to possess any certain prophylactic power.

There are remarkable variations in opinion as to its influence in curing syphilis. At one time discussion ran high regarding its use; and, of course, extreme statements were made on both sides, while the facts adduced never warranted the extreme conclusions.

Consequently, at one time mercury has been regarded as capable of absolutely preventing the constitutional affection; at another time it has been accused of giving to the syphilitic virus the impulse which sets up the constitutional affection. It is now quite certain, however, that mercury administered continuously to the extent of salivation, or approaching it, exerts a poisonous influence, and produces constitutional effects very similar to those produced by syphilis (GRAVES); and Hunter himself says "new diseases arise from mercury alone;" while it cannot be doubted that in cases in which mercury has been freely given, we are never certain that secondary symptoms may not supervene. Bärensprung, of Berlin, during his most extensive experience, has come to the conclusion that syphilis not only can be cured without mercury, but he avows that under its use the disease is often rendered latent for months and years, and its complete cure delayed. He is of opinion that mercury deteriorates the constitution, and favours the development of destructive local affections. The non-mercurial treatment is slower, but surer; starvation and Zitmann's * decoction being the means he employs. He believes that the proportion of cases of constitutional syphilis to those of chancre has greatly diminished since mercurial treatment has been discontinued (*Ann. de Berlin Charité*, ix., 1, 1860; *Syden. Society Year-Book,* 1861). Herman has come to similar conclusions, from his experience in the syphilitic wards of the Vienna Infirmary. He believes that the non-mercurial treatment is much more speedy and successful than the mercurial; that no relapses occur; and that cutaneous eruption is much more frequent and severe in patients who have taken mercury. The experience of Diday is not less decided. He states that mercury cannot now be said to cure syphilis radically, so as to render all relapse impossible. Its warmest advocates do not, in the present day, claim more for it than the power of delaying only the appearance of the first syphilitic manifestations, and of hastening the disappearance of certain other lesions. He imputes to it positively, and on sufficient clinical evidence, the following disadvantages:—1st. It tends to render the primary ulcer phagedenic; 2d. It tends to induce *stomatitis* and *necrosis* of the alveolar borders; 3d. It produces an acute affection of the gastro-intestinal mucous membrane, and dyspepsia: 4th. It brings on trembling of the extremities, apoplexy, and insanity. All of these results he has seen supervene, even when the treatment by mercury was superintended and directed by the most competent and attentive practitioners.

He does not, however, withhold mercury in every case. If the primary lesion becomes an indurated, *woody* chancre, mercury is to be given. If the chancre is a doubtful one, he recommends

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* Zitmann's decoction is of two kinds—the stronger and the weaker. The former is compounded as follows:—℞. Rad. Sarzaparillæ, ℥xii.; Aquæ, ℔xxiv.; *Coque per horas duas et adde* Aluminis, ℥iss.; Hydrarg. Chloridi, *mitis* (calomel), ℥ss.; Antimonii Oxy. Sulphureti, ʒi.; *misce.* Coque ad ⅔, *et adde* Fol. Sennæ, ℥iii.; Rad. Glycyrrhizæ, ℥iss.; Sem. Anisi, ℥ss. *Infunde per horam et cola.* The dose of this decoction is half a pint to a pint morning and evening.

The weaker decoction is compounded as follows:—*Cupiat residuum* decocti fortioris et adde Radicis Sarzaparillæ, ℥ii.; Aquæ, ℔xxiv.; *Coque per horas duas et adde* Cort. Canellæ, Cort. Limonum, Sem. Cardamomi, ā ā ʒiii. *Infunde per horam et cola.* The dose of this decoction is one pint at intervals during the day.

waiting till some of the early constitutional phenomena render the nature of the case evident, and indicate the probable gravity of the syphilis with which he has to deal. He employs *iodine, iron*, and *quinine*, on the appearance of slight relapses, with a tonic and supporting regimen. He recommends *iodides*, to combat the *chloro-anæmia*, and to relieve the pain of tertiary ulcerations.

Numerous examples may be seen in museums, which show that the poisonous effects of mercury produce the worst lesions of the two; and, when combined with the syphilitic virus in a strumous person, the worst of all. In the extreme of syphilitic infection, it ought never to be forgotten that a specific chlorosis results from syphilis, amounting to anæmia; and that mercury will bring about a similar anæmia; while numerous instances are quoted by authors, of the poisonous effects of mercury inducing lesions similar to those of syphilis.

Both kinds of treatment (mercurial and non-mercurial) have been extensively tried since 1816, and formal experiments have been organized on the subject, namely,—*First*, In 1822, in Sweden, by Royal command, when reports were annually furnished from civil and military hospitals as to trials of the two methods; *Second*, Dr. Fricke experimented in the Hamburg General Hospital, and published his results in 1828; *Third*, In 1833 the French Council of Health published a report on the subject.

From all these accounts more than 80,000 cases were submitted to experiment, and they go to show that syphilis is cured in a shorter time, and with less chance of constitutional effects, by the simple than by the mercurial treatment.

It is extremely interesting and gratifying to be able to say that long before any of these reports were initiated, the surgeons of the British army perceived the ravages of the combined poisons of mercury and syphilis, and had the boldness to declare themselves against the system of treatment with mercury, and to introduce the milder measures of non-mercurial treatment.

The credit of this improvement is mainly due—(1.) To Mr. Fergusson, who practised it during the Peninsular wars (*Med.-Chir. Trans.*, vol. iv.); (2.) To Mr. Rose, of the Coldstream Guards, at the same time, but independently of Mr. Fergusson; (3.) To Dr. John Thomson, the first Professor of Military Surgery; who by lectures in the University and College of Surgeons in Edinburgh, and by his published writings, was mainly influential in convincing Scotch medical men of the evil effects of mercury in venereal diseases. The inquiry, begun in 1816 by these military surgeons, requires to be re-investigated with all the present advanced knowledge of the nature of the disease which we now possess, and with a better prospect of detecting the fallacies which surround the investigations. Under the simple treatment of those eminent men, there can be no doubt that mixed cases of soft, as well as of indurated chancres, and specific or syphilitic sores, were allowed spontaneously, as it were, to develop their distinctive characters. No confidence can now be placed in the results derived from clinical observation, where the cure of soft, suppurating, and mixed sores, gonorrhœa, vegetations, suppurating buboes, are all indiscriminately given as evidence of the cure of syphilis; and cases cannot be accepted as cured at the time they are simply discharged from present treatment, because they may seem to be progressing to a favourable termination, but not absolutely cured.

Nomenclature, as already explained (page 748), must now be specially attended to.

The present position of opinion with regard to mercury in the cure of venereal sores seems to be this, namely,—That it is a very valuable remedy in some cases of syphilis, but not in cases of soft chancre; and the difficulty is to express always the nature of the cases for which it is most suitable. Even those who believe most fully in its virtues acknowledge that in primary affections, as when given in the treatment of the local sore, its administration will not *prevent the occurrence* of constitutional symptoms; nevertheless, the value of mercury in the cure of THE INDURATION of the true *infecting chancre* is now fully recognized. The local lesion, if it appears after the usual prolonged period of incubation, is as much a manifestation that the constitution is already affected as is the developed vesicle of *variola vaccina* a manifestation that the constitution is affected with variolous poison. Looking, also, to the nature of the virus of syphilis, as expounded in the text (especially at page 747), the *excision* of the *primary lump* or sore—the *specific induration*—as practised by Dr. Veale (*Edin. Monthly Journal*, July, 1864), and by Dr. Humphry, of Cambridge (*British Medical Journal*, August 13, 1864), is a justifiable operation; for the original sore, when it has become a "lump" (as in its state of "woody-like" induration), is an undoubted maintainer of infection and of contamination of the system. If, therefore, it can be easily and completely insulated, as when on the *prepuce*, the cure of the constitutional symptoms may be facilitated.

There are also certain forms of secondary syphilis for which the administration of mercury is unsuitable. These are the pustular eruptions, or ecthymatous states, in rupia and in syphilitic anæmia. For the cure of other secondary symptoms mercury is certainly of service. If given to the extent to which I have limited its use in the text, I believe that secondary symptoms disappear more rapidly under its regulated use than by any other plan of treatment. All our treatment of syphilis rests on that evidence which must always guide the hand of the physician, namely—practical experience. That has certainly taught us that the mercurialism of John Hunter's time was an error; and that its regulated administration in cases of *syphilis* is undoubtedly beneficial, and especially during the evolution of the specific symptoms of infection. Dr. Jeffrey Marston, of the Royal Artillery, has given an admirable summary (*British Medical Journal* of Feb. 21, 1863) of the means and indications of treatment by mercury which he has found most useful. His experience shows that the system ought to be affected as slowly as possible; and there ought to be a remission of the remedy for a time as soon as that effect has been attained. As soon as the symptoms for which the mercury was given have disappeared, steel and other remedies ought to be given; and in three cases where the general health seemed to have suffered, *podophyllin* in small doses (*one-sixth* of a grain), with extract of *belladonna*, was given with marked benefit. If the system is too early brought under the influence of mercury, and the symptoms are not benefited, *chlorate of potash* in *compound tincture of cinchona* may be given with advantage; and in strumous subjects the *bichloride of mercury*, dissolved in *ether* and added to *cod-liver oil*, is found to be most useful. Some of the more intractable forms of syphilitic *squama* are best treated by a combination of *liquor arsenicalis*, solution of *bichloride of mercury* in very small doses, and tincture of *sesquichloride* of iron; while the use of soap in ablution ought to be avoided (STARTIN).

In the administration of mercury for the cure of syphilis, *salivation*, or anything approaching to that condition, should

℞ Liq. Hydr. Perchlor ʒi,
Tinct. Cinch. Co ʒi.
Aqua ad ℥i
Bis d. s.

never be induced. *Tenderness of the gums* should be the utmost physiological effect very gradually and gently brought about. The *primary sore* should be healed without mercury; but so soon as the evolution of constitutional symptoms has commenced, such as the specific induration of the sore or glands, cutaneous, scaly, tubercular, condylomatous affection, or iritis, the sooner mercurial treatment (to the extent indicated) is commenced the greater will be the benefit. But where *suppurative lesions* have been established, mercury ought to be withheld altogether, or very sparingly combined with *iodide of potassium.*

Iodide of potassium, in doses adjusted to the individual case, appears to act with rapid benefit in some of the syphilitic diseases of the interior of the cranium giving rise to extreme pain. Its administration often causes intense suffering in patients who have been treated by mercurials. Two distinct effects are produced: *first,* the compounds of mercury fixed in the body are rendered soluble and active; and, *secondly,* a form is given to them which allows of their elimination, with more or less rapidity, in a state of combination with one of the elements of the iodide; and thus the patient is subjected anew to a mercurial treatment by the compounds of mercury already present in his body (Melsens in *Brit. and For. Med.-Chir. Review,* 1853). The dose of *iodide of potassium* should at first be small —not more than *fifteen grains* in the twenty-four hours—increasing the dose, if the patient bears it well (MELSENS, GUILLOT). Its action is aided by a blister over some portion of the shaven scalp, and by having the blistered surface dressed with mercurial ointment; and, generally, it may be said that local treatment gives very valuable aid. For example, cutaneous or mucous *raised papules* remaining persistent, an ointment composed of *oxide of zinc, calomel,* and *simple cerate,* hastens their absorption. Eruptions of lichen, acne, and herpes are similarly benefited by the application of *oxide of zinc lotion* or *ointment;* and if *prurigo* and *urticaria* be also present, *diacetate of lead lotion* will expedite the cure. Vesiculo-crustaceous spots will cease to re-appear if the affected parts are painted for a few days with a solution of *nitrate of silver* (gr. x.-xx. to ℥i.), and *oxide of zinc* lotion applied afterwards.

In the more advanced stages of the suppurative affections, the use of pyogenic counter-irritants ought not to be neglected, such as tartar-emetic ointment. They tend to keep up just so much of a discharge as may be consistent with the strength of the patient; and are worthy of a trial on the principle explained under *syphilization*.

In the dry forms of syphilitic cutaneous diseases, and in *chronic eczema* of the extremities, tar ointment, or an alcoholic solution of tar, is an excellent application; and the disappearance of indolent glandular swellings is greatly aided by the use of strong solutions of iodine. Superficial forms of ulceration attending the pustules of *ecthyma* are benefited by the use of solutions of *nitrate of silver* or *sulphate of copper*, and generally by caustics and local stimulants. If a sloughing condition threaten ulcerating sores, lotions of the *potassio-tartrate of iron* will generally improve their aspect. In *psoriasis palmaris*, and similarly fissured conditions of the skin, *glycerine lotions* are most useful. But all these local remedies, it must be remembered, are only aids to the constitutional treatment, whether by mercury or iodide of potassium, or simply by a well-regulated hygiene. The patient, during the whole of the treatment, should be warmly clad—should be fed upon a good but plain diet—should take plenty of exercise in the open air—should use occasionally (once or twice a week) warm baths—and avoid stimulants, unless specially indicated and prescribed.

The administration of mercury, to affect the system, is best effected through the agency of the mercurial vapour bath. It is a mode of administration not liable to affect the digestion, and it permits other remedies to be given by the mouth at the same time, if they be considered necessary. It is also mild, slow, and equable in its action,—so that it is safer than many other plans. The mercurial vapour bath is to be managed in either of the following ways. The first method is best adapted for the practice of a large institution; the method recommended by Mr. Lee is better suited for private practice:—

> “The patient is seated on a chair, and covered with an oil-cloth lined with flannel, which is supported by a proper framework. Under the chair are placed a copper bath, containing water, and a metallic plate, on which is placed from one to three drachms of the bisulphuret of mercury, or the same quantity of the grey oxide, or the binoxide of this metal. From five to thirty grains of the iodide of mercury may be employed, or a scruple of the iodide, with a drachm and a half of the

bisulphuret. Under the bath and plate spirit-lamps are lighted. The patient is thus exposed to the influence of three agents,—heated air, steam, and the vapour of mercury. At the end of five to ten minutes perspiration commences, which becomes excessive in ten or fifteen minutes longer. The lamps are now to be extinguished; and when the patient has become moderately cool, he is to be rubbed dry. He should then drink a cup of warm decoction of guaiacum or sarsaparilla, and repose for a short time" (LANGSTON PARKER).

Mr. Henry Lee's mode of proceeding is more simple:—"A special and convenient apparatus is used (made by Savigny & Co.), which consists of a kind of tin case, containing a spirit-lamp. In the centre, over the flame, is a small tin plate, upon which from fifteen to thirty grains of calomel is placed, while around this is a sort of saucer, filled with boiling water. The lamp having been lighted, the apparatus is placed under a common cane-bottomed chair, upon which the patient sits. He is then enveloped, chair and all, in one or more double blankets, and so he remains well covered up, for about twenty minutes, when the water and mercury will be found to have disappeared."

The corrosive sublimate (*Hydrargyrum corrosivum sublimatum*) is perhaps the next best form of administration; and where it has to be continued over many weeks, may be given in the following form, with opium (TANNER):—

℞. Hydrarg. Corrosiv. Sublimat., gr. ii.; Pulveris Opii, gr. v.-viii.; Pulveris Guaiaci, ℥ss.; *misce;* Fiant. Pilulæ, xvi. One twice or thrice a day.

With regard to *sarsaparilla* as a remedy, Sigmund, Syme, and many other acute observers, have come to the conclusion, after long and careful trials of the best sarsaparilla, that it does not, *per se*, exercise the slightest perceptible influence on the course and termination of syphilitic diseases. It is usually given in combination with some mercurial preparation, as in the decoction of Zitmann (page 777, note).

Preventive Treatment.—From what has been written, it must appear clear that the only chance of preventing infection, alike on the part of the male and the female, is personal cleanliness after sexual intercourse with strangers. The good that has resulted from police inspection of females, as in Paris, Brussels, and other places, has been greatly overrated; and I believe it is mainly to be attributed to the greater attention to personal cleanliness which such inspections have brought about. If a man shall have sexual intercourse with a strange woman, let him wash the penis immediately after the act, taking care to cleanse thoroughly the folds of the *prepuce,* especially near the *frænum,* and in the sulcus of the *corona glandis.* If a woman shall have sexual intercourse with a strange man, let her use a syringe with hot water, to wash out the vaginal surface, taking care to cleanse thoroughly the folds of mucous membrane at the orifice of the canal and of the *labia pudenda.* Medical inspections are formal, and look useful, leading, undoubtedly, to greater personal cleanliness, and may be the means of detecting soft chancres, and so may prevent their being communicated; but the *infecting* sore, the true *syphilitic* one, can rarely be detected in a female. The real preventive remedy is the most ancient, the most simple, and the most efficient—wash, and be clean.

CHAPTER VIII.

ON THE NATURE OF THE ACUTE SPECIFIC OR GENERAL DISEASES.

THE two orders of diseases which have now been described constitute a group of diseases sometimes termed "*acute specific*" (WALSHE) or "*general diseases*" (WOOD), because they primarily and essentially implicate the entire system; and all of them, with the exception of dysentery, diarrhœa, croup, syphilis, and hydrophobia, may be comprehended under the term "general diseases." Throughout their course, and from the first, they each variously modify the composition of the blood, the calorification, and the enervation of the body. Each and all of them, also, during their progress, give rise to some lesions in the textures, of a special anatomical character, when the disease is not too rapidly fatal to allow of these pathological features to become developed, as in *yellow fever, typhoid fever, plague, cholera.* These maladies run an acute and rapid course; they are more or less pyrexial; and, in the majority of instances, the fever which accompanies them has a fixed duration. The greater number of them are contagious, or capable of being propagated from person to person, under certain conditions not yet well understood; and, lastly, all of them are produced by an extrinsic poison, either of a *miasmatic* or specifically contaminating nature, as in those of the first order, or by the implanting of a *specific virus*, as in those of the second order.

The *specificity*, so to speak, of these diseases consists in certain characters which distinguish each of them from any other disease, and in the constancy by which, from time immemorial, such characters have continued to distinguish them. Although medical opinions regarding their pathology may change, yet the essential characters of these "*acute specific diseases*" are not known to change. Each of these diseases observes a constancy and regularity of plan in the construction and development of its morbid processes (PAGET). Each of them has some essential character or characteristics by which they are severally distinguishable. The course of the febrile phenomena is found to be distinctive, the duration of the febrile state not less so, as well as the anatomical signs which distinguish the local lesions, the development of which are concurrent with the general or constitutional phenomena; and of all truths relating to the phenomena of disease, the most important are those which relate to the order of their succession. *Specificity* cannot be denied to those diseases in which, during their natural course, we find that every phenomenon is related (in a uniform manner, so far as *exact* investigation has extended) to certain phenomena that co-exist with it, and to others that have preceded and will follow it. When it is found that a series of phenomena occur in (thousands, millions) x number of instances in the same order, within similarly uniform periods of time, and altogether with so much regularity that those who are instructed, on visiting a patient for the first time, can not only affirm what has gone before, but may predict what is to come after (the highest achievement of science)—it is impossible to avoid concluding that such an invariable sequence has as constant a cause. This conclusion flows from the very constitution of our nature, and is inevitable; and on our knowledge of the facts relating to such order of succession is founded every reasonable anticipation of future events, and whatever power we possess of influencing those phenomena in the management of the disease, to the advantage of our patients and the community at large. When it is found, moreover, that there are many series of these phenomena, which may be called A, B, C, D, &c., occurring in different persons, and at different times, all perfectly distinguishable, and never by any chance capable of being confounded by a properly trained person, it is impossible to avoid concluding that the causes of A, B, C, D, &c., are not identical, and must be in fact dissimilar. Moreover, mere *uniformity* in the sequence of such phenomena as obtains in the natural course of the respective diseases is of itself enough and sufficient (to most minds) to warrant the belief that the diseases they represent are specific. This view of the specificity of each of these diseases may be held independent of the causation of them being also specific; but the term "specific," from this point of view, necessarily means that such unlike effects must have unlike causes; and the term "specific," as we use it, is derived simply from the fact that (following the analogy of natural history) the different diseases just named A, B, C, D, &c., have been considered as so many different species, preserving their individuality through all time, as the rose, the apple, the dog, the whale, or any other animal or plant preserves theirs. Like animals and plants also, such specific diseases may disappear from off the face of the earth, when they can no longer "struggle for existence" against the well-directed measures of sanitary science. These measures may eventually be capable of rendering the existence of many specific diseases an impossibility—as much so as the existence of a megatherium or even a wolf would now be an impossibility in this country.

The *origin* of all specific diseases, or "how their respective first *contagia* arose," is alike unknown. "This in Pathology is just such a question as in Physiology is 'the origin of species.' Indeed, it is hardly to be assumed as certain that these apparently two questions may not be only two phases of one. Hourly observation tells us that the *contagium* of small-pox will breed small-pox, that the *contagium* of typhus will breed typhus, that the *contagium* of syphilis will breed syphilis, and so forth; that the process is as regular as that by which dog breeds dog, and cat, cat,—as exclusive as that by which dog never breeds cat, nor cat, dog; and prospectively we are able to predict the results of certain exposures to contagion as definitively as the results of any chemical experiment. But retrospectively we have not the same sort of certainty; for we cannot always trace the parentage of a given case of small-pox or measles" (Simon, *Sixth Report on Public Health*, p. 54). The same may be said of animals: given any individual calf, cat, dog, or child, we cannot always trace its parentage.*

With regard to their causes, therefore, each of them appears to be produced by some distinct morbific agent—some morbid poison—a poison or virus which is capable of being multiplied in the body during the development of the particular disease. In this respect they are capable of self-augmentation (Paget). No evident fresh cause is applied, and yet the disease increases (e. g., *syphilis, small-pox, vaccinia, glanders, hydrophobia,* and *malignant pustule*). The theory of each of them, expressed in the most general terms, is, that each of them depends upon a definite specific virus, which induces a morbid condition of the blood; and that, during the development and course of the disease, the system endeavours to discharge or transform in some way the peculiar morbific agents which have given rise to the symptoms, or which have multiplied in the body during the course of the affection. The whole blood then seems to be diseased, and nearly every function and sensation in the frame is impaired or disturbed from the state of health before any local lesion is developed. Sometimes, indeed, the severest constitutional disturbances of a specific kind may co-exist with the smallest local development of any specific lesion (Paget); and Dr. Robert Williams has justly observed, and numerous examples have been noticed, in which "it may be laid down as a general law, that when a morbid poison acts with its greatest intensity, and produces its severest forms of disease, fewer traces of organic alterations of structure will be found than when the disorder has been of a milder character." Time, duration, or *chronicity,* is a peculiarly important and characteristic element in the nature of these diseases. They run a definite course; and we know of no specific remedy which will at once effect a cure and prove an antidote to the poison. The nearest approach to an antidote is that of quinine in the malarious fevers. They have all—(1.) A more or less defined period of incubation or latency; (2.) A period of development towards the *fastigium* or acmé of the disease; (3.) A period of *defervescence,* during which the febrile phenomena abate; (4.) Etiologically they are quite distinct from one another; and, lastly, a period of convalescence.

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* "And here," says Mr. Simon, "notwithstanding the obvious difficulties of proof either way, some persons will dogmatize that there must have been an overlooked inlet for contagium, while others will dogmatize that there must have been in the patient's body an independent origination of the specific chemical change. Presuming (as may pretty confidently be presumed) that in the history of mankind there was once upon a time a first small-pox case, a first typhus case, a first syphilis case, &c., and admitting our entire ignorance as to the combination of circumstances under which those first cases respectively came into existence, we have no scientific reasons for denying that new 'spontaneous generations' of such contagia may take place. But, as regards some of the diseases, there are conclusive reasons against supposing that this is of frequent occurrence. Where we can observe isolated populations, we find very long periods elapse without any new rise of certain 'species' of disease. For instance, in 1846, the contagium of measles was imported by a sick sailor into one of the Faroe Islands, and led to an epidemic which attacked more than 6,000 out of the 7,782 inhabitants; sparing only the persons who previously had had the disease, and 1,500 who were kept out of reach of contagion; but before that time *there had not for* sixty-five *years been, in those islands, a single case of measles.* And the statistical return to which I have already often referred (Parliamentary Paper, 1864, No. 12) contains another very striking illustration of the same sort of thing :—England has 627 registration districts. During the ten years 1851-60, scarlatina, small-pox, and measles were (as usual) prevailing more or less throughout the country, producing among children under five years of age an average annual mortality of 802 per 100,000; *i.e.*, by scarlatina 419, by small-pox 103, and by measles 280. In 626 of the registration districts there were deaths (and, for the most part, in not inconsiderable quantity) from one or more of those causes; not quite invariably from all of them; for forty-three of the 626 (thanks, no doubt, to vaccination) had not any death by small-pox, and among the forty-three districts which thus escaped mortality by small-pox, there was one which also had not even a single death by measles; but, with these exceptions, all the 626 districts had deaths from the three diseases—deaths by measles, deaths by small-pox, deaths by scarlatina. But the 627th district had an entire escape. In all the ten years it had not a single death by measles, nor a single death by small-pox, nor a single death by scarlet fever. And why? Not because of its general sanitary merits, for it had an average amount of other evidence of unhealthiness. Doubtless, the reason of its escape was that it was insular. It was the *district of the Scilly Isles;* to which it was most improbable that any febrile contagion should come from without. And its escape is an approximative proof that, at least for those ten years, no contagium of measles, nor any contagium of scarlet fever, nor any contagium of small-pox had arisen spontaneously within its limits. I may add that there were only seven districts of England in which no death from diphtheria occurred, and that, of those seven districts, the district of the Scilly Isles was one. Still, to say that a disease is contagious is not to say that it may not arise without contagion," (SIMON, l. c.)

The causes, then, of A, B, C, D, &c., being thus specifically different, it still remains to be determined what these causes are. This is now being done by the principle of exclusion chiefly—*i. e.,* that such and such an alleged cause cannot produce such and such effects. Thus it is now certain that cold and change of temperature never cause a *specific* disease such as any of those described; that mere moisture in the air does not; that such and such gases do not, and so on. The question seems now narrowed to this point,—that in the case of many specific diseases (probably in all) the cause is something quite special, and, in fact, of unknown origin. Nevertheless, there are some, such as small-pox and syphilis, concerning which organic chemistry may enable us to learn more definitely the "*active principle*" (to use a pharmaceutical phrase) by which they are propagated; just as we have learned that *strychnine* is the active principle of *nux vomica;* or that *morphine* is of *opium;* or *digitaline* of *digitalis.*

We are as certain as we can be of anything that such an "*active principle*" exists in the pus or juice of certain pustules or papules in some of those specific diseases which are capable of being propagated by inoculation. "Thus the different ferments by which they severally are communicated have respective peculiarities of their own,—peculiarities which are primarily governed by the nature and anatomical relations of the morbid process in which each particular ferment originates. All of them are essentially unstable and transitory; but, while some of them tend under ordinary circumstances to undergo a rapid extinction, others of them can with comparative ease retain their power for long periods of time, and some apparently have not their full force till some time after they have left the diseased body; e. g., *cholera.* Some of them associate themselves indistinguishably with one or more of the common excretions and exhalations of the body, others are separately tangible in vesicles and pustules, or at ulcerating or suppurating surfaces, and may or may not also exist in other products of the body; some of them are evolved in small quantity, others in very large quantity, or with very large natural admixture; some of them are fixed, others but very scantily volatile, others as volatile as if they were vapours; some of them operate easily on a second body by mere contact (more or less prolonged) with the outer or inner surface to which they are applied, others are not found to act unless they come into contact with accidentally abraded surfaces, or be thrust into the bodily substance by inoculation. Thus, in vaccine lymph and in the matter of chancres respectively, there is a *contagium* which we know only in a fixed form, and only as communicable by intentional or accidental inoculation. Also ophthalmia and gonorrhœa and glanders are communicable by the fixed *contagium* which their pus contains; but this *contagium* does not need inoculation to infect the mucous membrane to which it is applied; and as regards ophthalmia, there are reasons for suspecting that to some extent the contagious pus may retain its activity when dry enough to float as dust in the air. In some forms of *milzbrand* (including, probably, the so-called 'malignant pustule,' which is the best known human form of the disease) the highly virulent fluids can, it is alleged, infect by soakage through the cuticle. In diphtheria the characteristic exudation is capable of infecting by contact; and though often the disease is communicated from person to person without any manifest transplantation of matter, it may be that in such cases particles of the decomposed false membrane are conveyed as a volatile *contagium.* Cholera and typhoid fever send forth their respective *contagia* for the most part, if not exclusively, as matter dissolved or suspended in the evacuations which pass from the patient's bowels; and probably these evacuations (which, at least in cholera, gradually develop their full infective force after their discharge from the body) can under some circumstances bring into similar contagious fermentation the excrement with which they are mingled in privies, drains, and cesspools, and can thus convert the effluvia and leakage from such sources into means of extensive secondary infection of air and water. The volatile *contagium* of hooping-cough is probably disengaged in large quantities by the air-passages, and as it forms, is sent forth with the breath. In typhus, small-pox, measles, and scarlatina the diffusion of volatile *contagium* occurs to a vast amount, probably with all exhalations from the body; and in addition to this, contagium, more or less fixed, collects abundantly about the patient's person and bedding; and, in a far less degree, something of the same sort probably occurs in erysipelas" (SIMON, l. c.) As regards the spread or modes of propagation of these diseases, each of them "has its own laws of communicability,—laws which must be properly understood if the danger of contagion is to be guarded against. The communication of some diseases (of *scabies,* for instance, and *favus*) is not by any true product of the human body, but consists in the migration of parasites, or germs of parasites, animal or vegetable, from one person's body to another,—a migration which of course the recipient may to any extent facilitate by dirty personal habits, and which, as regards some parasitic diseases, can scarcely be conceived to occur otherwise than in consequence of such habits" (SIMON). The communication of the diseases that have been now considered takes place by that process which is distinctly called zymotic:*—in the first affected body, and by or with a specific chemical transformation of some of its material, there is generated or multiplied a specific *zymé*, *contagium*, or *ferment;* which, if transferred while active to a second (not accidentally insusceptible), will there, according to the common law of ferment, excite the same morbid phenomena, the same chemical changes, as those amid which itself was begotten" (SIMON, l. c., p. 53).

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* "Some of these expressions," says Mr. Simon, "are meant to hesitate between two particular assertions. In this respect they correspond to the uncertainty which at present prevails as to the exact nature of some or all morbid ferments. A few years ago it might have seemed permissible to describe without reserve the contagion of the zymotic diseases, as but some changing organic material of the first affected body. At present, however, reserve on that point is necessary. That th power of contagiousness is associated with such changing organic material is certain; but whether the power be *proper to the material*, or be only *contingently* its attribute, seems to require further investigation. The recent very interesting experiments of Professor Schröeder in Germany, and of M. Pasteur in France (published respectively in Wöhler and Liebig's *Annalen der Chemie*, and in the *Comptes Rendes de l'Académie des Sciences*), aim at proving, most extensively, an essential dependence of specific fermentatory and putrefactive changes on the presence, in each case respectively, of some characteristic molecular living thing; and they give it to be understood that, if certain fermenting or putrefying organic matters tend by their contact to bring a given quiescent organic compound into chemical excitement like their own, this contagious power of theirs depends on their carrying with them those distinctive microscopical animal or vegetable forms which in each case respectively are the true agents of change. The conclusiveness of those experiments in the field to which hitherto they have been confined is still matter of the warmest scientific controversy; and while, therefore, it would be at least premature for me to insist upon them as evidence even in that field, it would be yet more premature for me to speculate on the possible results of an extension of similar researches to the pathology of zymotic diseases. But it is impossible to ignore their very important bearing in that direction. It may be that broad distinctions will have to be drawn among the diseases which I here speak of as zymotic, or at least between them and some or all of the traumatic infections. Indeed, I gather from Canstatt's last Jahresbericht that already M. Monoyer, of Strasburg, in a recent work on Fermentation, has attempted a beginning in this matter. As connected with the argument in my text, it may be worth while to mention here that the different sorts of vibriones which M. Pasteur describes as the essential powers in putrefaction are, according to him, not only independent of atmospheric air, but are killed by it; so that, for instance, when butyric acid is forming in a saccharine solution, the butyric fermentation may at will be stopped by a current of atmospheric air, which kills the vibrionic ferment; though, on the other hand, a current of carbonic acid may traverse the solution for an indefinite time without affecting that infusorial life."

CHAPTER IX.

PATHOLOGY OF THE DIETIC ORDER OF ZYMOTIC DISEASES.

Combined researches in chemistry, physiology, and pathology, during recent years, have cleared up much that was doubtful, and established certain principles on which proper scales of diet may be founded, so as to maintain the health of the body under a great variety of conditions as to labour, confinement, freedom, and exercise. Statistics have shown more decidedly now than hitherto how intimately disease and mortality are associated with the supply of food to the people. The records of the Registrar-General of England, and those of Sir William Wilde in Ireland, the evidence of the Commissioners relative to the supplies in the Crimea during the war against Russia in 1854, 1855, and 1856, and many valuable reports relative to the health of the Navy before and after their diet was changed, fully substantiate these statements.

While physicians were well aware of the intimate connection that existed in a general way between food and disease, it is due to the labours of chemists and physiologists especially that this connection has been reduced to an intelligible form, and that the principles which they have established are now put to a practical use.

Effects of Food on the Animal Economy.—The great fact which recent chemical and physiological investigations have established may be expressed thus:—" *That the various alimentary substances made use of by man and animals contain at least four classes of constituents, each of which performs its own assigned function in the living animal economy. If the substance contains nitrogen, it seems most fitted for the nourishment of tissue, and has been called plastic or nitrogenous; if it is deficient in nitrogen, and has an excess of carbon or hydrogen, it appears to undergo combustion in the body, and is called a non-nitrogenous or a respiratory element of food (hydro-carbons); if it is fatty in its nature, it performs the double duty of maintaining animal warmth, and of assisting in the assimilation of nitrogenous compounds; and, lastly, if it is saline in its quality, it goes to build up the solid textures of the animal frame, and aids the important*

2500 C
300 N

work of carrying new materials into the system, and old or effete matter out of it" (LETHEBY). Man and animals cannot maintain health if their food does not contain all of these constituents; and common instinct, with experience, tells us that these classes must be associated in due proportions, under a variety of modifying circumstances. There are undoubted *habits* of feeding which, while they appear to be dictated by common instinct, are also sanctioned by science. For example, white meat being deficient in fat, bacon is eaten with veal and with fowl; melted butter is used with fish; eggs and butter are mixed with sago, tapioca, and rice; cheese is eaten with maccaroni; salads and vinegar are eaten with cold or salted meat; a vegetable is mixed with an animal diet; bread is eaten with butter, bacon with greens, pork with pease pudding, and so on. Old habits and instincts not only declare that these combinations are compatible, but Science informs us now why such combinations are demanded for the maintenance of health; and when they cannot be obtained, health is endangered, the constitution is gradually altered, temperament is modified, life is shortened, families extinguished, armies are swept from their encampments, and races of men from the face of the earth.

The experience of Dr. Christison (who has paid great attention to this subject for the last twenty-four years) has shown,—(1.) That the most successful dietaries for bodies of men, deduced from practical observation, contain carboniferous and nitrogenous food in proportion of about three of the former to one of the latter by weight. (2.) That while *nitrogenous* may replace *carboniferous* food for supporting respiration, *though at a great loss, carboniferous* food (without nitrogen) cannot replace *nitrogenous* food for repairing textural waste. (3.) The daily amount of nutritive principles of both sets must increase with exercise and exposure, otherwise the body quickly loses weight, and ere long becomes diseased. If the above proportion between the two sets be maintained, the weight of real nutriment per day varies, for adults at an active age, between seventeen and thirty-six ounces; the former being enough for prisoners confined for short terms, the latter being required for keeping up the athletic constitution, or that which is capable of great continuous muscular efforts. (4.) Dietaries ought never to be estimated by the rough weight of their constituents, without distinct reference to the real nutriment in these, as determined by physiological and chemical inquiry.

17 — 36

Nit^s 4 - 5
Carbs 14 - 15
Fatty 1 - 2½
Water 70 - 130

Salts ℥ß - 1

Approximately, it may be concluded that a full-grown man of average weight (140 to 150 lbs.) and height (5 feet 7 inches) requires *one-twentieth* part of his weight in food during the twenty-four hours; that is, *seven* or *seven and a half* pounds of food, including solids and liquids; *one to one and a half* pounds (16 to 24 ounces) being solids, the rest water (PARKES).

On an average, it is found that a man requires *four* or *five* ounces of chemically dry NITROGENOUS food daily;—that in a state of rest he will require *three and a half* ounces; under a state of considerable exertion *five and a half* ounces; and under extraordinary exertion he may require as much as *six and a half*, or even *seven* ounces of dry *nitrogenous* aliment daily. The quantity of HYDRO-CARBONIFEROUS aliment required to keep a man in health cannot be less than from *fourteen and a half* to *fifteen* ounces in twenty-four hours; and even *nineteen* to *twenty-two* ounces under great exertions. The amount of FATTY MATTERS ought to equal about half the quantity of the *nitrogenous* aliment. But in a state of rest about *one* ounce in the twenty-four hours will be sufficient; while under great exertion *two and a half* ounces may be required daily. The amount of WATER required varies from *seventy* to *one hundred and thirty ounces;* and the SALTS supplied in the food should amount to from *half an ounce* to *an ounce* daily, consisting of *chloride of sodium,* chloride of potassium, salts of *lime* and magnesia, carbonates, citrates, lactates, and acetates (PARKES).

To determine by calculation the amount of these different aliments, and therefore the nutritive value of a given diet, the following scale is given, (Table I.) It shows the mean amount of water, nitrogenous substances, fat, and carbo-hydrates—starch and sugar—which ought to be contained in 100 parts of each of the substances in common use mentioned in Table I.*

The calamities which befell our soldiers in the Crimea (in 1854) show that the dietaries of working men cannot be safely reduced below the physiological standard; and, in the words of Dr. Christison, "any person conversant with the science of the present subject could have foretold, as a certain consequence, sooner or later, of their dietary, that the British troops would fall into the calamitous state of health which befell them in the Crimea."

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* This table is used by Dr. Parkes in the Laboratory of the Army Medical School, and he kindly permits me to give it here.

TABLE I.—NUTRITIVE VALUE OF FOODS IN 100 PARTS (Parkes).

	Water.	Nitrogenous Substances.	Fat.	Carbo-hydrates, Starch and Sugar.
Meat without Bone,* . .	74	16	9	...
Fat of Meat,†	63	14	14	...
Bread of average quality (White Wheaten), . . .	40	8	1·4	51
Starch, ...	...	...	...	100
Fat, ...	...	...	100	240 of Starch.
Pease, ...	15	24·4	2·6	49
Potatoes, ...	74	1·5	0·6	29
Rice, ...	10	3·8	0·8	85·2
Milk, ...	87	4·3	3·7	5·2
Maize (after Pozziate), . .	13·5	9·9	6·7	64·5
,, (Von Bilra), . .	10·6	15·09	3·8	67·46

* The mean of usual statements.
† Calculated by Dr. Parkes from the statements of Lawes and Gilbert.

TABLE II.—DIETARIES AND THEIR NUTRITIVE VALUES (Letheby).

Diets.	Weekly Consumption in Ounces.							Daily Ditto.		
	Bread or Biscuit.	Meat.	Potato.	Meal, &c.	Milk.	Cheese.	Butter.	Carboniferous.	Nitrogenous.	Total solid Nutriment.
Physiological, . . .	140	84	..	..	..	..	3·5	12·7	4·0	16·7
Prison Punishment, .	112	..	..	..	..	..	..	8·2	1·4	9·6
E. County & Borough Jails—										
Under 7 days, . .	121	..	..	23	39·5	..	..	12·4	2·2	14·6
Not hard labour, .	172	7·8	3·2	22·8	15·4	3·5	..	15·7	3·1	18·8
Hard labour, . . .	163	14·6	63·4	27·2	41·6	1·5	..	18·2	3·5	21·7
Scotch Prisons—										
Under 3 days, . . .	112	..	..	28	..	..	..	11·2	1·9	13·1
Not hard labour, .	30	7·5	152	73	175	..	..	19·0	3·4	22·4
Hard labour, . . .	76	10	176	100	175	..	..	27·0	4·5	31·5
Irish Prisons—										
Under 1 month, . .	56	..	192	70	70	..	..	19·5	2·9	22·4
Not hard labour, .	56	..	192	60	170	..	..	20·5	3·4	23·9
Hard labour, . . .	64	..	219	70·5	170	..	..	22·0	3·6	25·6
Military Prisons—										
Under 84 days, . .	56	..	..	119	210	..	..	22·2	3·8	26·0
Over 84 days, . . .	56	..	..	168	210	..	..	27·8	4·7	32·5
Destitute Debtors, . .	156	16	52	22	21	..	..	16·3	3·1	19·4
Convict Prisons, . .	161	36	112	12	12·8	..	..	18·4	3·6	22·0
Unions (Adults), . .	112	15·5	51	17	34	5·2	1·1	14·2	2·8	17·0
Unions (Children), .	90	14	32	..	105	..	3·5	11·1	2·3	13·4
Lunatic Asylums, . .	114	23	68	16	14	7	1·3	13·2	4·0	17·2
Public Hospitals, . .	93	52	56	14	7	..	3·2	12·1	3·5	15·6
Army—										
Crimea, ...	112†	112	..	..	..	..	..	14·5	4·8	19·3
Home, ...	168	84	112	..	..	..	..	19·4	4·8	24·2
Madras, ...	112	112	56	4*	..	..	..	16·5	4·9	21·4
Bombay, ...	140	112	56	56*	..	..	..	22·2	5·6	27·8
Field (India), . . .	168	..	..	168*	..	..	..	30·7	3·8	34·5
Navy, ...	112†	112	56	..	..	..	..	17·7	5·0	22·7
‡ Navigator (Crimea),	140	140	..	28	..	..	..	17·8	6·2	24·0
‡ Navigator (Home), .	320	96	64	..	..	12	4	18·6	7·7	26·3
Berwickshire Labourer,	122	..	..	224	224	..	..	37·1	7·0	44·1
Yorkshire Labourer, .	280	126	28	..	210	..	49	42·2	8·8	51·0

In this table only the most important articles of diet are mentioned, although the others, excepting beer, spirits, tea, and coffee, are calculated in the daily consumption. (*) are rations of rice, and (†) are of biscuit. Gruel is calculated at rate of two ounces meal per pint.

‡ A name given to those labourers who are employed in excavating, and such-like laborious work, chiefly connected with the construction of railways. They are also sometimes called "navvies."

TABLE III.—NUTRITIVE VALUE OF FOODS (LETHEBY).

Substances, 100 Parts.	Water.	Fibrine, Albumen, &c.	Starch, Sugar, &c.	Fat.	Salts.	Carboniferous.	Nitrogenous.	Total Nutriment.
Human Milk,. . . .	89	3·5	4·2	3·0	0·2	11·4	3·5	14·9
Cows' Milk, ...	86	4·5	5·0	4·1	0·7	14·8	4·5	19·3
Skimmed Milk, . . .	87	4·5	5·0	2·7	0·7	11·5	4·5	16·0
Butter Milk, ...	87	4·5	5·0	0·5	0·7	6·0	4·5	10·5
Beef and Mutton, . .	73	19·0	..	5·0	2·0	12·0	19·0	31·0
Veal, ...	77	19·0	..	1·0	0·6	2·4	19·0	21·4
Poultry, ...	74	21·0	..	3·0	1·2	7·2	21·0	28·2
Bacon, ...	20	0·8	..	70·0	1·3	168·0	0·8	168·8
Cheese (Chedder), . .	36	29·0	..	30·0	4·5	72·0	29·0	101·0
,, (Skimmed), .	44	45·0	..	6·0	5·0	14·4	45·0	69·4
Butter, ...	15	..	..	83·0	2·0	199·0	..	199·0
Eggs, ...	74	14·0	..	10·5	1·5	25·0	14·0	39·0
White of Egg, . . .	78	20·0	..	..	1·6	..	20·0	20·0
Yolk of Egg, ...	52	16·0	..	30·0	1·3	72·0	16·0	88·0
White Fish, ...	79	19·0	..	1·0	1·2	2·4	19·0	21·4
Salmon, ...	78	17·0	..	4·0	1·4	9·6	17·0	26·6
Eel, ...	80	10·0	..	8·0	1·3	19·2	10·0	29·2
Wheat Flour, ...	15	11·0	70·0	2·0	1·7	74·8	11·0	85·8
Barley-meal, ...	15	10·0	70·0	2·4	2·0	75·8	10·0	85·8
Oat-meal, ...	15	12·0	62·0	6·0	3·0	76·4	12·0	88·4
Rye-meal, ...	15	9·0	66·0	2·0	1·8	70·8	9·0	79·8
Indian-meal, ...	14	9·0	65·0	8·0	1·7	84·2	9·0	93·2
Rice, ...	14	7·0	76·0	0·3	0·3	76·7	7·0	83·7
Haricot, ...	19	23·0	45·0	3·0	3·6	52·2	23·0	75·2
Pease, ...	13	22·0	58·0	2·0	3·0	62·8	22·0	84·8
Beans, ...	14	24·0	44·0	1·4	3·6	47·4	24·0	71·4
Lentils, ...	14	29·0	44·0	1·5	2·3	47·6	29·0	76·6
Wheat Bread, . . .	44	9·0	49·0	1·0	2·3	51·4	9·0	60·4
Rye Bread, ...	48	5·0	46·0	1·0	1·4	48·4	5·3	53·7
Potatoes, ...	74	2·0	23·0	0·2	0·7	23·5	2·0	25·5
Green Vegetables, . .	86	2·0	4·0	0·5	0·7	5·0	2·0	7·0
Arrow-roots, ...	18	..	82·0	..	..	82·0	...	82·0

In this table the carboniferous matter is calculated as starch; 10 of fat being equal to 24 of starch.

The preceding very interesting tables (II. and III.) of dietaries and their nutritive values, and of the nutritive values of foods, by Dr. Letheby, of London, are given here to show the actual proportions in which various substances used as food are associated in the several public dietaries of the country, and as a guide to the student of medicine when, as a practitioner, it may often be his lot to devise and construct scales of diet suited to various conditions of existence.

In cases where preserved food must be used for want of fresh food, there are difficulties to be overcome which experience and science have made to disappear in a great measure. It is known that salt meat has a tendency to engender disease, and to favour the development of disease under certain circumstances; but it is not known, either physiologically or chemically, what is the exact nutritive value of salt meat in a scientific point of view. There are three circumstances connected with its use which tend to diminish its value as an article of diet, namely,—(1.) The investigations of Liebig demonstrate that the process of salting meat is very improper, for the brine extracts the juices of the flesh, and so removes most of the important constituents. (2.) The salt meat for the navy and for soldiers in the field is always highly salted, in order to keep for two years or more in every climate; and such highly salted meat must be so thoroughly steeped in cold water, to remove the salt, before it is eatable in large quantity, that much of its most nutritive constituents must be washed out—namely, its albumen and sapid extract, called osmazôme (CHRISTISON). (3.) The sarcolemma of salted meat is always hardened; and hence those foods require a long time for digestion, and frequently disagree with the stomach (LETHEBY). Few can eat a pound of salted meat daily for any length of time, even when fed on rations by no means liberal. Nitrogenous elements must therefore be added to a diet where salted meat predominates, rather than increase the amount of that substance; and this is best done by adding pease, flour, currants, raisins, and oil, butter, or lard, to the ration.

"Experience has shown," says Dr. Letheby, "that there are certain articles of food which are not particularly nourishing in themselves, but which serve some very important purposes in the animal economy. This is the case with tea and coffee: in fact, the use of a vegetable infusion, containing astringent matter and an active principle rich in nitrogen, has been almost universal among mankind from the earliest times."

"The physiological action of these beverages appears to be of a somewhat singular kind; for while they excite the brain, they calm the nervous system generally, and though they produce a state of wakefulness and activity, yet they also induce a species of languor and repose. Lehmann has ascertained by experiment that coffee greatly diminishes the wear and tear of the system: it oils the machinery, as it were, and checks the waste of friction; for those who use it find that during active exercise the destruction of tissue is prevented, and that there is less demand for food; in fact, with a maximum of work to perform, and a minimum of food to accomplish it, he will best sustain his vital power who resorts now and then to a cup of tea or coffee. Hence its value as a means of economizing food, and hence its importance to the poor labouring man." In many of our large merchant-ships the crews are engaged on the condition that coffee shall take the place of grog; and those captains who are careful of the health of the men, give them warm coffee before or after they have been aloft in cold and stormy weather—a practice which cannot be too much overvalued.

Effects of Overfeeding.—Too much respiratory food favours the development of fat, and checks the proper nutrition of the muscular tissues; hence it is that rice feeders and potato eaters, and those who indulge in fermented liquors, are often bloated in their appearance, become extremely fat, and are not capable of prolonged exertion. The brewer's drayman is a bad subject for the wards of an hospital; for though he usually has all the appearance of a man possessed of great muscular strength and vital endurance, yet he is not so in reality, for the muscular tissues have been encroached upon by fat, and the general power has been weakened by an undue influence of the respiratory element. Most of the animals in our menageries, from a too liberal allowance of respiratory food, die from fatty degeneration. Accumulation of the nitrogenous elements in the blood is often also a prolific source of disease, and their non-elimination (as shown in previous pages) is conducive to the propagation and development of many *miasmatic* diseases. Attention has now been drawn to the influence of such a condition in establishing the characteristic diseases of overfed convicts (LETHEBY, THOMPSON).

One of the most distressing results of overfeeding from a wrongly adjusted dietary is *corpulence*. Much has been written on the subject of *corpulence;* and the attention of the public has been recently successfully arrested by one who appreciated the relief he obtained by following the directions of a physician who happened to take a scientifically correct view of his case. Mr. Banting (whose pamphlet on the subject of "corpulence" is now well known) managed to reduce his physical proportions under the following dietary:—

Breakfast—Four or five ounces of beef, mutton, kidneys, boiled fish, bacon, or cold meat of any kind (except pork), a large cup of tea (without milk or sugar), and one ounce of dry toast. *Dinner*—Five or six ounces of any fish (except salmon or eels), any meat (except pork), any vegetables (except potatoes or rice), one ounce of dry toast, fruit out of any pudding, any kind of poultry or game, and two or three glasses of good claret, sherry, or Madeira (champagne, port, or beer forbidden). *Tea*—Two or three ounces of fresh fruit, or a rusk or two, and a cup of tea without milk or sugar. The tea may be very much enjoyed when taken in the Russian fashion—*i. e.*, with a thick slice of lemon floating on the top instead of milk. *Supper*—Three or four ounces of meat or fish, similar to dinner, with a glass or two of claret. *Nightcap*, if required, a tumbler of grog (gin, whisky, or brandy, without sugar), or a glass or two of claret or sherry.

The quantities of the different articles specified in this liberal diet-roll, Mr. Banting states, must be left to the natural appetite, but for himself he took at *breakfast* six ounces of solid and eight of liquid food; at *dinner*, eight ounces of solid and eight of liquid; at *tea*, three ounces of solid and eight of liquid; at *supper*, four ounces of solid and six of liquid; and the *nightcap* he introduces to show that it is not injurious; whilst, for the encouragement of smokers, it may be mentioned that tobacco is allowable.

When Mr. Banting began this treatment in August, 1862, he weighed 202 lbs., and after a year's perseverance in it, in September, 1863, he had lost 46 lbs., and had reduced his girth 12¼ inches. The sound dietetic principles on which corpulence ought to be treated had been previously enunciated by Dr. T. K. Chambers, in his excellent monograph on that subject; and Mr. Banting's dietary is in exact accordance with what is there stated, and with what has been stated in the text. A still more varied dietary might be prescribed on similar principles by reference to the tables at pages 795 and 796.

Effects of Deficient Food.—"A deficiency of food, especially of the nitrogenous part, quickly leads to the breaking up of the animal frame. Plague, pestilence, and famine are associated with each other in the public mind, and the records of every country show how closely they are related. The medical history of Ireland is remarkable for the illustrations of how much mischief may be occasioned by a general deficiency of food. Always the habitat of fever, it every now and then becomes the very hotbed of its propagation and development. Let there be but a small failure in the usual imperfect supply of food, and the lurking seeds of pestilence are ready to burst into frightful activity. The famine of the present century is but a too forcible illustration of this. It fostered epidemics which had not been witnessed in this generation, and gave rise to scenes of devastation and misery which are not surpassed by the most appalling epidemics of the Middle Ages. The principal form of the scourge was known as the contagious famine fever (typhus), and it spread, not merely from end to end of the country in which it had originated, but, breaking through all boundaries, it crossed the broad ocean, and made itself painfully manifest in localities where it was previously unknown. Thousands fell under the virulence of its action, for wheresoever it came it struck down a seventh of the people, and of those whom it attacked one out of nine perished. Even those who escaped the fatal influence of it were left the miserable victims of scurvy and low fever. Another example, not less striking, of the terrible consequences of what may be truly called famine, was the condition of our troops during the early part of their sojourn in the Crimea, in 1854. With only just enough of food to maintain the integrity of the system at a time of repose, and at ordinary temperatures, they were called upon to make large muscular exertions, and to sustain the warmth of the system, in the midst of severe cold." (LETHEBY).

In cases of very gradual starvation an urgent feeling of hunger is not a prominent symptom, and even when it exists at first, it usually soon diminishes, and is succeeded by a feeling of exhaustion and faintness, and even loathing of food, if abstinence has been long protracted (R. B. HOLLAND). The mental condition connected with poverty may in part account for this deficiency of appetite. A depression produced on the nervous system is very early manifested in the impaired energies of all the vital functions, the weakened conditions of the intellectual faculties and moral feelings, and diminution of the general sensibility. Disturbance of the cerebral functions is at first shown by an unnatural languor, despondency, and listlessness, slowness and hebetude of intellect, with an inability to employ the thoughts steadily and profitably on any subject. Notwithstanding all this general languor, however, the patient sometimes manifests a highly nervous state; he is startled by any sudden noise, and hurried by the most trifling occurrences. He is liable to attacks of giddiness, "swimming in the head," staggering, dimness of sight, with temporary delirium, and either falls as in an apoplectic fit, or lapses gradually from a lethargic state into one of stupor, or even of complete coma. In many respects the symptoms in these cases have a considerable resemblance to the effects of exposure to cold. In consequence of the torpor of the brain and intellectual faculties, it is often extremely difficult to obtain the requisite information from patients. Instead of showing any anxiety to communicate the symptoms and cause of their illness, or to relate the privations they have undergone, they generally have an unwillingness to be questioned, lie in a listless or lethargic state, without taking any notice of what is going on, and seem desirous only not to be disturbed. Such listlessness and torpor of the mental faculties, the tendency to fainting, or to perfect syncope, and, finally, a state of cerebral oppression, amounting in some cases to coma, are among the most characteristic symptoms of defective nutrition, and the surest indications of its existence to a serious extent.

NB

In February of 1862 a man, thirty-six years of age, was discovered in a stack, near Morpeth, dying from starvation. All attempts to rally him failed, and he ultimately died. He was an intelligent man, and had been editor and proprietor of a penny journal called the "*Falkirk Liberal.*" A diary was found in his possession, containing entries of his condition from the 8th to the 25th of February; from which it appeared that during *seventeen* days he had twice tasted a piece of bread; but for the last *thirteen* days he had been entirely without food. During the first *ten* days of the *thirteen* he was able to obtain water, but on the *eleventh* day he found his legs were useless, and he lost all motor power in the lower extremities, so that "one-half of his body appeared to be dead." The case is of interest to the pathologist, as showing the length of time during which existence can be maintained if water alone be taken.

When privations of clothing and lodging are added to insufficient diet, long exertion, insufficient repose, intemperance, and the miseries of poverty, the symptoms already detailed are of the most aggravated kind. "Long before insufficiency of diet is a matter of hygienic concern—long before the physiologist would think of counting the grains of nitrogen and carbon which intervene between life and starvation—the household will have been utterly destitute of material comfort;—clothing and fuel will have been even scantier than food; against inclemencies of weather there will have been no adequate protection; dwelling-space will have been stinted to the degree in which overcrowding produces or increases disease; of household utensils and furniture there will have been scarcely any,—even cleanliness will have been costly or difficult; and, if there still be self-respectful endeavours to maintain it, every such endeavour will represent additional pangs of hunger. The home, too, will be where shelter can be cheapest bought,—in quarters where commonly there is least fruit of sanitary supervision, least drainage, least scavenging, least suppression of public nuisances, least, or worst, water supply, and, if in town, least light and air. Such are the sanitary dangers to which poverty is almost certainly exposed, when it is poverty enough to imply scantiness of food" (Simon, *Sixth Report on Public Health,* 1864, p. 14). But a multitude of cases of minor degrees of suffering occur in which the symptoms are less marked than those described. Such cases are indicated by a sallow and dingy appearance of the skin, a soft and flabby feeling of the flesh, more or less emaciation, general debility, feebleness of the circulation, and frequently swelling of the ankles. The stomach becomes disordered, the appetite defective, and digestion impaired. The individual feels languid and desponding, is soon fatigued, incapable of exertion, and has an irresistible desire to fall asleep, from which he is apt to awake suddenly and in a fright. The body is easily chilled, breathlessness and palpitation are experienced after slight exertion, attacks of *vertigo, tinnitus aurium,* and transient blindness, are common, and there is a peculiar forlorn and dejected aspect of countenance which is very characteristic. This state of things is commonly soon succeeded by some specific disease; though it sometimes continues, with only slight variation, for a very protracted period, until the patient falls by slow degrees into a state of mental as well as physical incapacity; and, being no longer able to procure any employment, is completely invalided, and applies for medical relief. It may perhaps be thought that these remarks apply to cases of deficient nourishment which are less frequent; but the experience of those who have practised extensively among the wretched purlieus and miserable abodes which exist in every large metropolitan town can testify to the contrary. I well remember listening to the interesting clinical lectures of Dr. Christison, of Edinburgh, on the cases of *scurvy* which prevailed in that town and its vicinity in 1847, and hearing the melancholy recitals of misery and starvation under which the poor suffered at that time; some under the hard taskmasters of the illegal "truck system,"* and others from absolute want at home. Among many, of whose cases I have preserved notes, a shoemaker had to support his wife and five children on *eight shillings* a week; and, to feed his children better than himself, he subjected himself to privations which in time developed scurvy. His daily diet consisted of *one pennyworth of bread, with tea, but no milk, in the morning—no dinner—and one pennyworth of bread, with tea, and no milk, in the evening.* After existing *three months* on this diet the disease broke out. But, apart from these extreme cases, the instances are innumerable in which deficiency of food acts as a pre-disposing cause of many diseases. It is now generally known that plethora and symptoms of an opposite state very nearly resemble each other, and a discrimination of these differences is of the greatest importance. While coma is often an attendant on plethora, it is not to be forgotten that it is one of the most severe and fatal signs of exhaustion from defective nutrition; and when it supervenes towards the termination of diseases of exhaustion, and the pulse becomes slower, it often acquires a degree of fulness, and gives an idea of strength, quite at variance with its previous character, and little to have been anticipated from the debilitated state of the system.

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* The "*truck system*" became developed chiefly during the formation of our great lines of railway throughout the country. The labourers (navvies) were poor,

But in degrees far short of what is popularly known as starvation or famine, insufficiency of nourishment may bring very hurtful consequences to health. Local defects or local peculiarities of diet may exercise an important influence in determining or colouring particular localizations of disease; and generally it may be said, that in order justly to estimate the sanitary circumstances of a people, sufficient regard must be had to the quantity and quality of the people's meat and drink (Simon, *Report on Public Health*, p. 11, 1864).

The injurious effects produced by improper nutrition require to be studied both in relation to food and drink; and the diseases which belong to this order are *scurvy*, *purpura*, *famine fever*, *alcoholism*, and probably also *rickets*. The place of *cretinism* and

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and came to work without money to buy provisions, and their field of labour was often far removed from any place where food could be bought in quantity. The contractors, their employers, then established provision stores, and in place of paying the men in money, they compelled them to take remuneration for their labour by value received in food. By this method, now declared illegal under all circumstances, the labourers often suffered from a deficient and bad supply of provisions.

bronchocele cannot be said as yet to be definitely determined. According, however, to recent investigations, these diseases are found among people of all habits in the countries where they abound, only where the soils are composed of magnesian limestone rocks, where the waters contain an excess of magnesian salts, in France, Germany, England, Sardinia, America, and India. (See page 202.) Through the water, therefore, as an element of diet, these diseases appear to become developed, and, therefore, in the meantime, they may be arranged among the diseases of this order, some of which now demand a detailed description.

CHAPTER X.

DETAILED DESCRIPTION OF THE DIETIC ORDER OF ZYMOTIC DISEASES.

SCURVY.

Latin Eq., *Scorbutus;* French Eq., *Scorbut;* German Eq., *Scorbut;* Italian Eq., *Scorbuto.*

Definition.—*A chronic morbid state ushered in by debility, lassitude, lowness of spirits, attended by fetor of the breath, sponginess of the gums, which swell by irritation, till they overhang the teeth in palmated excrescences. Livid subcutaneous patches and spots appear upon the skin, of considerable extent, especially on the lower extremities among the roots of the hair. Spontaneous hæmorrhages may take place from the mucous canals; contractions of the muscles and tendons of the limbs occur, with pains, and sometimes superficial ulcerations. An altered state of the albumen of the blood is associated with this condition, and the phenomena are brought about by a deficient supply of the organic vegetable acids, or of the salts of fresh vegetables.*

Pathology and Historical Notice.—Scurvy is mentioned by Pliny as having occurred in the Roman army commanded by Germanicus after a long encampment in Germany beyond the Rhine. It prevailed to a frightful extent in the army of Louis IX., when he was made prisoner in Egypt in 1260. With fish only for fresh provisions, dispirited by being obliged to act on the defensive, and harassed unceasingly by the Saracens, the Christian army was almost annihilated by a most terrible outbreak of scurvy. But it was not till navigation was improved, and long voyages undertaken, that this disease became well known from its general prevalence and formidable character. Vasco de Gama, in his first voyage to the East Indies by the Cape of Good Hope, in 1497, lost 100 men out of 160 by this affection. James Cartier, in his second voyage to Newfoundland, in 1535, speaks of sufferings still more severe. Of 110 people there were not ten whole. "This malady being unknown to us," he writes, "the body of one of our men was opened, to see if by any possible means the occasion of it might be discovered and the rest of us preserved. But in such sort did the malady increase, that there were not above three sound men left. Twenty-five of our best men died; and all the rest were so ill that we thought they would never recover again." A decoction of the leaves and bark of a tree, supposed to be a species of spruce fir, was the remedy which they found restored health and recovery. "It was scurvy which used to decimate our navy, and render long sea voyages almost impossible. It was mainly by scurvy that Anson, in his celebrated voyage of 1740-2, lost within the first ten months nearly two-thirds of his crew, and during the remaining period about half of the survivors. Scurvy continued to prevail, with little abatement, till 1764. The voyages of Sir R. Hawkins, Hosier, Anson, Drake, Cavendish, Dampier, Byron, and of numerous other navigators, furnish similar details, and show how recklessly the lives of sailors were sacrificed (COPLAND). But at last it was against scurvy that Cook had attained his triumphant success, when, in 1775, after three years' absence, he brought back a healthy crew, which, out of 112 men, had lost only one by disease. During the sixteenth, seventeenth, and earlier part of the eighteenth century, the disease was endemic * in towns, fortifications, camps, and armies. "Many thousands were often cut off within a few months in single armies and garrisons; and it is probable that more seamen perished from

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* It is a mistake to call scurvy *epidemic*, as has sometimes been done. The term cannot be applied with propriety to diseases other than the *miasmatici*,—diseases which we have seen to depend upon the presence of specific poisons which enter the blood by impalpable media, and common, therefore, in a greater or less extent, to all classes of the community.

scurvy alone than from all other causes combined, whether sickness, tempest, or battle" (Wood). In this country and in America it is now very little known, and many have never seen the disease; unless they have lived in seaport towns.

The days when scurvy was most prevalent were not those in which many *post-mortem* examinations were made, and our earliest knowledge of the morbid anatomy of this disease is derived principally from Poupart and Lind. They tell us that in those cases in which flux or dysentery is absent, the intestines have been found perfectly sound, however copious the hæmorrhage from them may have been. The principal effects of the disease were observed in all cases in the cellular tissue of the extremities. The quantity of congealed blood effused in that part, even where no stain or mark could be perceived on the skin, was quite astonishing. "It often lies," says Lind, "in large concrete masses on the periosteum, while the bellies of the muscles of the legs and thighs seemed quite stuffed with it, often an inch in thickness." He often found water effused into the cavities of the chest and abdomen, and no less frequently blood,—the quantity of blood effused in all parts sometimes amounting, in his opinion, to no less than a fourth part of that contained in the whole body. Poupart gives some further particulars, and says that on moving the limbs of some scorbutic patients a noise is heard; and that on examining the joints the epiphyses had entirely separated from the bones; and in other cases, that the cartilages of the sternum had separated from their bones; and bones that had united after being broken, very often separated again at the site of fracture. He says that if we squeezed the ribs which had begun to be thus separated from their cartilages, "there came out abundance of corrupted matter, so that nothing was left of the rib but its bony plates." The mesenteric glands were usually enlarged; the spleen, often three times bigger than natural, fell to pieces, as if composed of coagulated blood. In two cases examined at St. Thomas's Hospital by the late Dr. Robert Williams, patches of ecchymoses were found under the pericardium covering the heart, and also under the arachnoid membranes covering the brain.

In some endemics of scurvy there is a marked tendency to the effusion of dark liquid blood into the serous cavities, and of the synovial membranes, the most common site being into the pericardium, then the pleura, and next the peritoneum (Karawagen).

The spleen is often enlarged, distended with blood, and soft. The texture of the muscular system is also soft and flabby. The blood appears to be deficient in red particles (Busk, Becquerel, Rodier, Andral, Fricks), and does not impart a stain to the lining membrane of the heart and great vessels. A fluid or dissolved condition of the blood has also been noticed, appearing often as "a mere gore, not separating into crassamentum and serum, and putrefying soon. It appears to be starved of some essential ingredient." It flows with difficulty from the vein, and, after standing some hours, deposits a thick, muddy sediment, which subsides from a reddish serum; and in the last stage of the disease it becomes quite black (Rouppe). There does not, however, appear to be any evidence of deficient powers of coagulation in scorbutic blood; and so long ago as 1699, Poupart noted the large coagula found after death in the cavities of the heart. Three analyses of the blood were also made by Mr. Busk, before 1840, in all of which the quantity of fibrine was found to be above its normal standard. Stoeber, in 1845, came to the same conclusion; and so did Andral, on repeating analyses which at first led him to an opposite conclusion. Two facts of great importance, if confirmed, have been observed by Chatin and Bouvier. They have observed that the *albumen* of the blood does not coagulate under a temperature of 74° Cent., or 165·2° Fahr.—that is, from 5° to 8° Fahr. above the normal standard; so that the albumen of the blood undergoes some change in scurvy which increases its solubility. They also observed that the force of cohesion of the *fibrine* was so much lessened that they were unable to isolate it thoroughly from the red corpuscles, and it was this attraction of the fibrine and the red corpuscles which the early writers on scurvy attempted to describe by the terms "*agglutinated blood*," "*viscid* and *thickened crassamentum*" (Parkes "On the Pathology and Treatment of Scurvy," *Brit. and For. Med.-Chir. Review*, Oct., 1848). Thus all the phenomena of scurvy, and the conditions under which it becomes developed, point to the blood as essentially altered. What the alteration definitely consists in has not been yet determined; but it appears that the condition of the blood in scorbutus does not consist in the want of a due proportion of either of its three prominent constituents. The proportion may in some cases be deranged, but it appears that in all cases there is a deficiency or altered quality of some essential ingredient. The following statements by Drs. Copland, Watson, and Wood contain a summary of the opinions of the chemical pathologists of the present day who have specially investigated the nature of scurvy by analysis of the blood:—

Dr. Christison supposes that scurvy arises from the want of vegetable albumen or animal casein in the food; that it is the deficiency in the quantity of azotized aliment, and consequent insufficient nourishment of the body, which is the cause of scurvy. Dr. Garrod believes that the malady is caused by the absence of *potash*, and that potatoes, and other antiscorbutics owe their virtues to the *potash* they contain. The following are his conclusions:—(1.) That in all scorbutic diets *potash* exists in much smaller quantities than in those which are capable of maintaining health; (2.) That all substances proved to act as antiscorbutics contain a large amount of *potash;* (3.) That in scurvy the blood is deficient in *potash*, and the amount of that substance thrown out by the kidneys is less than that which occurs in health; (4.) That scorbutic patients will recover when *potash* is added to their food, the other constituents remaining as before, both in quantity and quality, and without the use of succulent vegetables or milk; (5.) That the theory which ascribes the cause of scurvy to a deficiency of *potash* in the food is capable of rationally explaining many symptoms of that disease. These propositions of Dr. Garrod's require much further investigation, and they are not supported by the most elementary and important facts in the history of scurvy. Both soda and potash are constant constituents of the animal body, and it appears that they are not capable of replacing each other. For example, we always find the potash to exist in large quantities in the ash of muscle, soda in very small quantities (BERZELIUS, LIEBIG). In the ash of the blood we find the relation reversed. It appears, also, that the muscular system requires the presence of potash; and we should therefore expect to find that where there is a deficient supply of this base, the effect would soon be manifested in the functions of that system. This we do not find to be the case in scurvy. Without any amount of wasting of the body, we may find marked muscular debility; but men in an advanced stage of *scorbutus* have been known to do severe labour, till even the approach of fatal syncope from the weakened action of the heart; and this, perhaps, is one of the earliest symptoms of the disease. "Opposed also to this theory," writes Dr. Wood, "are the facts that nitrate of potash has often failed to cure the disease, while it has been cured by the addition of pure citric acid; and that, after failure under treatment with the salts of potash, recovery immediately commenced when the patient was allowed to eat fresh vegetables." Trotter also always held the opinion that the real antiscorbutic principles in fruit and vegetables were the vegetable acids, particularly citric, oxalic, and malic acids; and to test the accuracy of his opinion, he made, in 1800, a series of comparative trials between *lemon juice* and pure *citric acid.* Both these remedies were furnished to eight or ten ships, and reports were then obtained of their effects. The result was that *citric* acid was found the most efficacious. Sir William Burnett, also, was in the habit of supplying convict ships with *citric acid* and *nitrate of potash,* as well as with *lemon juice,* in order that comparative trials might be made of the relative value of these remedies; and the official documents bearing on this point were carefully examined by Dr. Parkes, who considered that nothing could be more convincing than the evidence they contained, showing that the efficacy of *citric* acid was clearly proved, while *nitrate of potash* was shown to be inferior in curative power, (*On the Pathology and Treatment of Scurvy,* l. c.) The astonishing effects of *fresh* lemon juice have been evidently underrated by Dr. Garrod; and it is more probable that its virtues are due to citric and other acids than to potash. Dr. Aldridge contends for the influence which should be ascribed to a deficiency of phosphorus, sulphur, lime, and the alkalies, in occasioning scurvy. That something may be owing—a part merely—to the causes contended for by Dr. Aldridge is not improbable. But it is unnecessary to pursue this subject any further than very briefly to state, that one of the most evident changes from the healthy condition is seated in the blood, which is altered in composition either by the addition to it of some ingredient or ingredients, or by the absence of something which ought to exist in it; and the deficient ingredient may be one of the ordinary constituents of the blood, or it may be some principle or element entering into their composition. This deficiency is due to the absence of certain articles of diet; and the disease is known by experience to be at once cured by supplying those articles.

Symptoms.—The earliest are a change of colour of the skin, particularly of the face and eyelids. At the same time there are vague, wandering, rheumatic-like pains in the limbs, weariness, depression of spirits, and a longing for fresh vegetables and fruits. With these pains, however, there is no fever; the pulse is soft and natural, and the temperature of the body lower than usual, and great disorder of the respiratory function may supervene. The countenance appears pale or yellow, and bloated; there is great depression of the physical powers, followed by swelling of the gums, which become soft, spongy, and hang over the teeth in large fleshy-like palmated masses, very much disposed and readily excited to bleed; and the edges of the gums are purple where they are in contact with the teeth. Several old observers state, and Fauvel confirms the observation, that in old people without teeth these vegetations do not occur, and the gums remain comparatively unaffected. In one case he noticed that a single remaining tooth was surrounded by a mass of swollen gum; the tooth was extracted, and the gum immediately became level and firmer, while the other symptoms preserved their intensity. The swollen and fungus gums, as Dr. Parkes observes, have always appeared to be much more intense in cases occurring on shipboard; and it is not improbable that they are affected peculiarly because they are exposed to pressure and attrition. All parts suffer from pressure in cases of scurvy—the merest rub causes an ecchymosis, the slightest possible blow produces an extensive bruise, and the gums may suffer most from the causes already noticed. A small eruption (like flea-bites) of a purple hue is next seen on the lower extremities; and about the same time the muscles of the leg or thigh become hard and painful, and in a day or two the skin over the pained part becomes first yellow and then purple. This discoloration forms patches sometimes as big as the palm of the hand, and may extend over half the leg and thigh. The popliteal regions are a frequent site of this pain and discoloration, sometimes attended with œdema, especially of the ankles and feet. The discoloration is especially apt to show itself in the situation of old cicatrices, and injuries. The tongue is now white, the breath fetid, and the stools generally pale. As the disease advances, all these symptoms are aggravated. The loss of physical power increases, the purple spots have a tendency to ulcerate, and the ulcers are distinguished from all others by their putrid fungoid appearance and great tendency to bleed; old sores open, and the callus of broken bones has even been dissolved and their ends separated. Profuse hæmorrhages frequently take place from the mouth, nose, lungs, or bowels. The teeth become loose, so that they either fall out or may be taken out by the finger and thumb. The pulse hurries on to 120 or 140, and at length the patient sinks from diarrhœa or dropsy, and with effusion so sudden that he perhaps has walked a short distance and then died in a quarter of an hour afterwards. The duration of the disease is generally many weeks, and sometimes under the most favourable circumstances many months, the patient recovering his strength very slowly.

When the disease follows ague, obscure or irregular remissions or intermissions of febrile symptoms are observable, and more or less enlargement, with pains in the region of the spleen, is often detected. From the commencement of the disease the alvine evacuations are more or less disordered, but the change may not attract attention. At first costiveness prevails, but subsequently the stools become much more frequent and very offensive. Diarrhœa, with colicky pains, supervenes, and, with more or less attendant hæmorrhage, rapidly sinks the patient beyond hope of remedy. Dysentery frequently supervenes upon the scorbutic state, more especially when dysentery is epidemic, and this combination of maladies is sometimes termed "*scorbutic dysentery.*" The tongue, pale at first, becomes broad, flabby, and indented at the edges of the teeth. The great poverty of the blood causes the mucous membrane of the tongue and inside of the lips and cheek, as well as of the skin, to have a peculiar paleness, which contrasts remarkably with the appearance of the gums. The eyesight is frequently weakened, and night blindness (hæmeralopia or nyctalopia) has frequently been observed as a commencing and concomitant symptom; and a most distressing state is the inability to sleep at night.

> "The tendency to *swoon* in the most severe cases is sometimes so great that the slightest motion, or the erect posture, or even any trifling exertion, may be followed by fatal syncope. It is stated in the account of Lord Anson's voyage, that many of the men, although confined to their hammocks, ate and drank heartily, were cheerful, and talked with much seeming vigour and in a strong tone of voice, and yet, on their being the least moved, although it was only from one part of the ship to the other, and that in their hammocks, they have immediately expired; and others,

who have confided in their seeming strength, and have resolved to get out of their hammocks, have died before they could reach the deck. And it was no uncommon thing for those who could do some kind of duty, and walk the deck, to drop down dead in an instant, on any endeavour to act with their utmost vigour" (COPLAND).

With our knowledge now of the phenomena of embolism, may not the suddenly fatal end of such cases be due to the morbid condition of the fibrine of the blood already referred to?

Diagnosis.—The scorbutic state of the skin is to be distinguished from *flea-bites, bruise, typhus fever,* and from *purpura hæmorrhagica.*

Prognosis.—In the present day, when the patient can command medical care and proper diet, scorbutus, though tedious, is seldom fatal. When these, however, have been wanting, the mortality has been terrible. Lord Anson, it should be remembered, in his voyage round the world, lost above 200 men, and at last could not muster more than six fore-mast men in a watch fit for duty. At the commencement of our last war with France, on the fleet returning from sea, it often happened so many men were landed ill of scurvy that even Haslar Hospital, large as it is, could not contain them, and many were lodged in the chapel, others in tents, while others died in the boats before reaching the shore.

Cause and Conditions under which Scorbutus is Developed.—In the Middle Ages scurvy prevailed to so great an extent that it was said to be epidemic among the inhabitants of the low countries of Holland, Friesland, Brabant, Pomerania, Lower Saxony, and, indeed, all countries from the 50° to the 60° of north latitude. This has been attributed to the absolute want of winter food for the cattle, so that it was necessary to kill them on the setting in of the frost, and either to salt or dry the flesh. Food was deficient and of improper quality, and hence the large stores of salt provisions found in the larder of the elder Spencer in the days of Edward II., even so late in the spring as the 3d of May. Six hundred bacons, eighty carcases of beef, and six hundred of sheep, was his abundant supply. In all these countries, however, in proportion as agriculture has advanced, and a succession of green crops has enabled the farmer to kill his best and fattest meats in winter, and in proportion as fresh vegetables have been introduced at our tables, together with a liberal use of wine and beer, so has this disease disappeared. The former universal prevalence of scurvy in the Navy, and its almost entire disappearance in the present day, necessarily has reference to a particular cause—the too exclusive use of salt provisions and absence of fresh vegetables. "In 1797 the victualling of the Navy was changed, greatly improved, and strictly regulated; and immediately consequent to the change the health of the seamen improved strikingly. Scurvy, typhoid fever, dysentery, and putrid ulcer, which up to the period of the change produced great havoc, became comparatively rare in occurrence and light in impression." Since 1797 the improvements have consisted in giving cocoa instead of gruel for breakfast, issuing salt meats at a much earlier period after being cured, the supply of better articles, and in greater abundance by one-third, the substitution of tea in the afternoon instead of spirits; but, chief of all, the use of fresh vegetables as often as possible: and, with every improvement in these respects, there has been, as a general result, a further improvement in health, till these four forms of disease, at no distant date so destructive, are scarcely known except by name.

It is now, however, completely established that salted meats are not more productive of scurvy than fresh meats, so far as concerns a monotony of diet. The experience of the Russians in 1720 and 1736, of the French in 1750-60, and of our own regiments at the Cape in 1836, sufficiently establishes this point. NB

Besides the injurious effects of cold and moisture, as well as impure air, combined with the conditions already noticed as tending to favour the development of scurvy, it is now well known that exposure for a lengthened period to the pernicious influences of a malarious district greatly aids in developing scorbutus. By observations especially devoted to this subject, I have determined that, amongst our troops who had been in Bulgaria during the war with Russia in 1854, there were two and a half *per cent.* of admissions for scurvy ~~amongst them~~ more than among those who served in the Crimea only; and that the deaths among them reported from this disease were also greater by three *per cent.* than among those troops who served in the Crimea, (*Glasgow Med. Journal*, July, 1857; and *Trans. of the Royal Med.-Chir. Society*, vol. xl.)

Recent combined researches have shown that scorbutic diseases were developed amongst our troops in the Crimea under the following conditions:—(1.) Deficiency of absolute nutriment; (2.)

Improper adjudication of the *nutrient* and *respiratory* principles of the *diet*—its monotony; (3.) Bad quality of the diet, and improper cooking, or none at all; (4.) Exposure to cold, combined with imperfect clothing, and labour beyond the strength of the best fed men; (5.) The persistent pernicious influence of residence in a paludal district (Bulgaria). But these circumstances are only to be regarded as the *occasional antecedents,* any one of which, or all combined, can never, *per se,* originate the disease.

NB

LOOKING TO THE HISTORY OF SCURVY, IT WILL BE SEEN THAT THE INVARIABLE AND INDISPENSABLE ANTECEDENT OF THAT DISEASE HAS BEEN A DEFICIENCY OR ABSOLUTE WANT OF FRESH VEGETABLE FOOD. Privation of vegetable food is its one essential cause. There is no other invariable antecedent; and there are sufficient reasons why it may not always be followed by scurvy. It is this antecedent which is the *vera causa* of *scorbutus;* and the most successful methods of prevention and of cure are in accordance with the hypothesis which assumes it to be the cause (Budd, Curran, Laycock, Parkes). "The giving of vegetable food is its one essential counteractive" (Simon).

Treatment.—The early history of navigation, as it records the greatest ravages of scurvy, so does it also record the best antidote to the disease. Of four ships which sailed from England in the beginning of April, 1609, for the establishment of the East India Company, they were all so severely visited by scurvy as to have lost nearly one-fourth of their crews when they arrived at the Cape of Good Hope. The crew of the Commodore's ship was not attacked. This immunity arose from three table-spoonfuls of lemon juice having been served daily to each of his men. But notwithstanding this evidence of the success of lemon juice in preventing scurvy—evidence the most conclusive—this valuable remedy and preventive was altogether slighted for a hundred and fifty years afterwards (Copland). Lord Anson's people, in 1740, on reaching the Island of Tinian, were recovered principally by eating oranges; and that noble, brave, and experienced commander was so convinced of their usefulness that, before he left the island, he ordered one man from each mess to lay in a stock for future security. Sir Charles Wager's people, also, were terribly afflicted with scurvy in the Baltic. Sailing, however, in the Mediterranean, and having heard how effectual oranges and lemons were in the cure of this disease, he took on board at

Leghorn a large quantity of them, ordered a chest each day to be brought on deck, and allowed the men, besides eating what they chose, to mix the juice with their beer, and to pelt each other with the rind, so that the deck was strewed with the fragrant liquor. By these means he brought his men home in good health.

In the year 1747 Dr. Lind made some comparative trials between this and some other modes of treatment (as vinegar, sulphuric acid, and tamarinds) on board the "Salisbury," at sea. As a general conclusion from his experiments, he affirms that orange and lemon juice, or more properly the citric acid obtained from all the species of the botanical genus *citrus*, or the natural order of fruits called *hesperidæ*, are greatly more efficient than any other remedy in the cure of scurvy.

Notwithstanding this strong opinion of Dr. Lind, the Navy continued to suffer severely from scurvy for half a century, till the Admiralty gave a general order for the supply of lemon juice. This salutary measure was accomplished by a representation from the Medical Board of the Navy, in the year 1795, when Lord Spencer was First Lord of the Admiralty, after a trial made on board the "Suffolk," of seventy-four guns. This ship sailed from England on the 2d of April, 1794, supplied with a quantity of lemon juice sufficient to serve out two-thirds of a liquid ounce daily to every man on board, and this was mixed with their grog, with two ounces of sugar. She arrived at the Madras roads on the 11th September, after a passage of twenty-three weeks and one day, without having had any communication with the land, without losing a man, and having only fifteen on the sick list. Scurvy appeared in a few of the men during the voyage, but disappeared on an increased dose of lemon juice being administered. "Let this fact," says Sir Gilbert Blane, "be contrasted with the state of the channel fleet in 1780, when Admiral Geary's fleet returned into port, after a ten weeks' cruise in the Bay of Biscay, with 2,400 men ill of scurvy; and let the state of this fleet be contrasted with that of the channel fleet in 1800, which, by being duly supplied with lemon juice, kept the sea four months without fresh provisions, and without being affected with scurvy."

In 1780 the number of cases of scurvy received into Haslar Hospital was 1,457; in 1806 *one* only; and in 1807 also *one*. While it is notorious that many medical men have never seen the disease, it is, as Dr. Budd has assured Dr. Watson, by no means rare in the hospital ship at Greenwich, which is often full of cases of scurvy; most of the patients so affected having just arrived in *merchant ships* from a long voyage; and some rumours are now abroad to the effect that scurvy is more frequent in the merchant service than heretofore—and, if so, the least that can be said is, that it is a disgrace to the merchant princes of a nation like Great Britain.* The disease, "so fatal when left to

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* With regard to the prevalence of scurvy among sailors in the merchant service, Dr. Barnes (Physician to the "Dreadnought" hospital ship) reports in 1864 to Mr. Simon that "of the entire number of cases admitted during the last twelve years into the Sailors' Home at Poplar, nearly half are, at the time of their admission, suffering more or less from scurvy, and of these perhaps a twentieth part seriously diseased with it; that of the entire number of cases admitted during the last twelve years into the hospital ship 'Dreadnought,' cases of scurvy have formed a twenty-fourth part; that to these must, of course, be added sufferers who are not taken into such establishments—a large but uncertain number of cases taken into the low lodging-houses of the water side; but that this is for London alone, and is not nearly all due to London shipowners; that of eighty-six cases of scurvy treated in the 'Dreadnought' during 1863, only fourteen came from ships which had issued from the port of London, while thirty-one came from foreign ships, twenty-one from Liverpool ships, eight from Sunderland ships, and twelve from Glasgow and other British ships; that Liverpool ships, besides furnishing to London a large proportion of the scurvy which is treated here, convey probably a much larger quantity of the disease to their own port of departure; that at all events, during 1863, fifty cases (all probably severe) were admitted at the Liverpool hospitals, and during 1862 a dozen cases at the Glasgow and Greenock hospitals; that shipowners of Liverpool and other northern ports, and of Hamburg and America, are those who exhibit the greatest amount of disregard of the safety and health of their crews. The plight in which the poor sailors from certain services are admitted is pitiable to witness. Disabled by hardship, semi-starvation, and ill-usage of every kind, they are cast out with the same indifference with which a worn-out block would be thrown overboard." When it is remembered that the security of this country has on several occasions been imperilled by the disablement of the Royal Navy through scurvy, it may be presumed that the same cause will imperil the safety of our merchant ships. And there can be no doubt that many ships have actually foundered at sea because the crews were so prostrate from scurvy as to be unable to handle them when overtaken by severe weather. It has been the custom to inquire what proportion of the crews were disabled from scurvy. As might be supposed in the case of a disease resulting from a cause operating upon the entire crew, this proportion is often very large. Thus there were recently admitted on board the "Dreadnought" twelve cases of severe scurvy from one ship; two others were known to be seriously affected; and the entire complement of officers and men was only nineteen, leaving but five men in all able for duty to work the ship. The proportion of crew disabled has ranged from 20 *per cent.* to 70 *per cent.;* and it is certain that scurvy ships have rarely a hand to spare. Deprive such ships of a fourth, a half, or two-thirds of their force, and the peril of a ship, cargo, crew, and passengers, in stress of weather,

Per week ℥ viij Preserved Potatoes
℥ ij – Vegetables
Lime juice ℥ iij + Pickles etc

itself, is cured with the greatest facility. Symptoms apparently the most grave and serious vanish as if by magic, and without leaving behind them any serious injury to the constitution. The sanious discharge from scorbutic sores has been known to change colour and to become healthy in a few hours after the commencement of treatment. In pure cases of scurvy the blood, and the blood only, is at fault," (PARKES, l. c.) "Lemon juice," writes Dr. Watson, "is really a specific against scurvy, whether it be employed as a preventive or as a remedy. It supplies something to the blood which is essential to its healthy properties." The potato seems to be no less efficacious as a remedy and preventive (BUDD). The reader will find a most interesting account of the efficacy of potatoes and of onions in Dana's *Two Years before the Mast*—a book well worth reading. The antiscorbutic principle, whatever it may be, is in greatest amount in unripe fruits; it lessens gradually as they ripen; and if the juice be obtained, it disappears when fermentation occurs. When lime juice becomes musty, a mucilaginous principle is developed at the expense of the citric and malic acids; and the *per centage* of citric acid gradually decreases (SIR WILLIAM BURNETT, PARKES). Good *lemon* juice seems to be more effectual, however, than pure *citric* acid; probably from its containing *malic* and *tartaric acids*, besides *citric*, and from the *citric acid* being in the form most easily absorbed and decomposed by the digestive organs of man. The Materia Medica gives numerous analogous examples of the superior efficacy of a medicine in its *natural combinations* (PARKES). This is all we can yet say, however, regarding the actions of either of these means of cure, notwithstanding the researches of the chemists of the present day. Moreover, it is sufficient: and with such remedies at command, the prevalency of scurvy in *merchant vessels*, or in any Navy, ought not to exist. "The one thing wanted in order that scurvy should be entirely banished from the *mercantile marine* is proper provision for the dietary of the crew,—such provision as is enforced in *emigrant ships*, where each person's weekly allowance must have in it at least 8 oz. of preserved potatoes, and 3 oz. of other preserved vegetables

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is obvious; and it must not be forgotten that where scurvy has prostrated a large part of the crew, the vigour of the remainder is sure to be sapped, so that there may not remain a single sailor before the mast in a state of thorough efficiency (Simon, in *Sixth Report on Public Health*, p. 19).

(carrots, onions, turnips, celery, and mint), besides pickles and 3 oz. of lime juice; where, also, there is considerable variety of bread stuff; and where, on two days in the week, preserved (not salted) meats must be given. With such a dietary as this, the details of which might be varied, provided its principle were adhered to, the occurrence of scurvy would be impossible. And even with dietaries inferior to that just described, scurvy would not occur as it does, if but the provisions of the 'Merchant Shipping Act' (17 and 18 Vict., c. 104) were obeyed,—that whenever a crew shall have been consuming salt provisions for ten days, lime juice or lemon juice and sugar shall be served out at the rate of half an ounce each per day; and if, during the voyage, the opportunities which offer themselves were fairly used for getting new supplies of fresh animal and vegetable food; but owners disobey the law, and captains neglect opportunities to cure the results of this disobedience. Owners, notwithstanding the law, will send forth their ships on long voyages without any provision of lime juice, or with lime juice insufficient in quantity, or with lime juice of which the quality is bad; and captains, with half their crews more or less disabled, are known to run past St. Helena or the Western Isles, when a few hours' delay would obtain sufficient provisions to repair the mischief occasioned by first neglect" (Simon and Barnes's *Sixth Report on Public Health*, 1864, p. 20).

It is perhaps hardly fair to attribute the improved health of the Navy entirely to the introduction of a daily allowance of lemon juice, considering that the quantity of the diet was greatly increased, and its quality greatly improved, contemporaneously with this addition. It is gratifying, however, to see how largely these combined measures have improved the health of the Navy, and rewarded the cares of those who superintend it; for during the nine years preceding these changes the sick seamen sent to the hospitals were 1 in 3·9, while in the nine succeeding years the proportion was only 1 in 8·4; so that not only has scurvy almost disappeared from ships of war and naval hospitals, but the efficiency of the Navy has actually been increased threefold.

PURPURA.

LATIN EQ., *Purpura;* FRENCH EQ., *Purpura;* GERMAN EQ., *Purpura;* ITALIAN EQ., *Porpora.*

Definition.—*A disease in which the blood or the capillary vessels throughout the system, or both, are altered, but the nature of the change is as yet not determined. There is evident constitutional disturbance throughout the disease, manifest by disorder of the digestive, the assimilative, and the excretory functions, attended by languor and debility; but it is a disease not usually attended by fever. The capillaries of the mucous and cutaneous surfaces are more especially implicated. Small round spots are visible on various parts of the surface, of a dull red or a deep purple colour. These are due to ecchymosis from the cutaneous capillaries beneath the cuticle through which the colour shines, and are of small size, except where they run together in patches. Hæmorrhage from mucous membranes are common, and also extravasations of blood within the substance of the several viscera.*

Pathology.—By some this disease has been considered identical with scurvy, and been named the "*land* scurvy." Others have considered it simply a disease of the skin—the *purpura simplex* of Willan and Bateman. Authors generally have spoken of the disease under the name of *petechiæ sine febre*, because the spots are not connected with continued fever. The disease is very closely related to *hæmorrhages* as a morbid state on the one hand, and to *scurvy* on the other; and therefore there may be distinguished two varieties—(*a.*) *simple* and (*b.*) *hæmorrhagic*, which latter is thus defined,—"*The disease when accompanied by hæmorrhage from a mucous surface.*"

It has not been determined what is the nature of the morbid state essential to purpura. In some cases the urine has been observed to contain an excess of albuminous matter, with a deficiency of urea (COMBE).* The blood has been found deficient in coagulating power. An examination of the blood in two cases of purpura, by Dr. Parkes, showed that, with a somewhat diminished proportion of the solid constituents in general, there was a remarkable increase in that of iron. A peculiar source of danger attends this disease in the occurrence of extravasation of blood into the internal organs. The lungs, the brain, the liver, and the alimentary canal are the most frequently affected. Purple spots and effusions of blood are to be found on the serous membranes, as in the *arachnoid*, the *pleuræ*, the *pericardium*, the *peritoneum;* and occasionally the blood lies coagulated in the cavities of these membranes. It has also been found in the bladder and in the calyces and pelvis of the kidney (CRAIGIE).

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* An interesting case may also be referred to, related by Dr. Goodfellow in his admirable lectures on *Diseases of the Kidney*, p. 74.

Instances occur in which blood oozes, or is discharged more or less copiously, from the mucous membranes without affection of the skin; and to this class of cases, as a form of disease now under consideration, are to be referred those cases of profuse or fatal hæmorrhage from slight causes, recorded under the name of "*hæmorrhea*," which have been ascribed to a *diathesis* termed the *hæmorrhagic*, and which is supposed to be hereditary, (*Edin. Med. and Surg. Journal*, vol. xxv.) When the disease is protracted the patient becomes of a sallow complexion, waxy coloured, and dingy; anasarcous swellings, gangrenous and bad sores appear on the feet and legs, general anasarca prevails, and he dies exhausted. Dr. Craigie considers that the appearance of purple spots in such cases is connected with more or less disease of the heart, especially with hypertrophy or dilatation of the ventricles. The following observation by Dr. Watson puts the pathology of purpura in an interesting and practical light:—

"I have adverted to one peculiar source of danger in purpura, the hazard that blood may be effused in some vital organ, where even a slight amount of hæmorrhage suffices to extinguish life. Dr. Bateman states that he had seen three instances in which persons were carried off, while affected with purpura, by hæmorrhage into the lungs. During the course of one week, in the year 1825, I was present at two inspections in the dead-house of St. Bartholomew's Hospital, illustrative of the same point in respect to another vital organ, and involving a question in forensic medicine. The subjects of examination were both of them women of middle age, who had been brought into the hospital covered with purple spots and bruise-like discolorations, and suffering hæmorrhage from the mucous membranes. Each of these women declared that the apparent bruises were marks of beatings received from her husband. One of them became suddenly hemiplegic a little while before she died. Of the manner of dissolution in the other case I am not sure. In both instances a considerable quantity of blood was spread over the surface of the brain between its membranes; and in one of them blood had been shed also into the cerebral substance, which it had extensively lacerated.

"It may be worth mentioning that in one of these corpses there were indications either of unusually rapid putrefaction after death, or (what I think more probable) of some degree of decomposition even before life was extinct. This woman died in the evening, and the body was examined next day, twelve or fourteen hours afterwards. A quantity of fetid gas escaped from the cavity of the abdomen as soon as it was opened, and small bubbles of air were seen to ooze from the areolar tissue of various parts of the body. Even when incisions were made into the *liver*, air frothed up, as it might do under ordinary circumstances from a section of the lungs" (*Lectures*, vol. ii., p. 866).

Symptoms.—Various symptoms, denoting general disorder of the constitution, precede the appearance of the petechiæ, generally by some weeks, such as languor which is oppressive, weariness, faintness, and gnawing pains at the pit of the stomach. The appetite is variable, generally weak, but sometimes there is an inordinate craving for food, which when eaten is said to lie with a weight upon the stomach. The tongue is yellowish, and coated with a viscid fur, the countenance is sallow or dingy, or has a bloated, pale appearance, with swelling underneath the eyelids. The purple spots appear first on the legs, and afterwards, without any certain order, on the thighs, arms, and trunk of the body, and their presence is attended with much weakness and great depression of spirits. No degree of pressure alters the colour of the spots, and they are distinguished from flea-bites by the absence of a central puncture. At first the spots are bright red, but in a day or two they become purple, afterwards brown, and when they are about to disappear they assume a yellowish tint. When the disease continues for a long time, all these varieties of colour may be seen on a patient at the same time.

The pulse is feeble, and generally a good deal quicker than natural. Deep-seated pains are felt about the epigastric region, as well as in the chest, loins, or belly. In some instances giddiness and lightness of the head prevail, especially when attempting to move or to stand erect, and there may be even dull pain in some part of the head. Constipation of the bowels, palpitation and irregular action of the heart, with a tendency to frequent syncope, are the most distressing and dangerous symptoms.

Causes.—They are not well known. It is a disease more common in women than in men; and, in boys, before than after puberty. It has appeared under the long use of a poor diet, much sedentary occupation, watching, mental distress, and anxiety. It has also appeared under very opposite conditions; for example, in persons accustomed to the use of nutritious food and free living, but in whom there is reason to believe the digestive functions and the constitutional powers have been impaired by the persistent abuse of spirits or malt liquors.

Diagnosis is generally between *Purpura* and *Scurvy*. The following are the principal distinguishing features of each contrasted:—(1.) Scurvy is most common late in the winter or early in the spring; purpura in the first seasons of summer and autumn. (2.) In scurvy the gums are uniformly soft, sore, spongy, swollen, and hæmorrhagic: this is no common feature in purpura. (3.) In scurvy tumors of a painful kind form in the extremities, with stiffness or contractions of the joints: such symptoms do not attend purpura. (4.) Scurvy is marked by extreme debility, and is rendered worse by blood-letting and by mercury, and is cured by the administration of lemon-juice: not so with purpura, which may require blood-letting for its cure, is not benefited by antiscorbutic remedies, and is sometimes speedily cleared away upon the supervention of mercurial salivation and hypercatharsis (WATSON and WOOD).

Dr. Graves, of Dublin, has described an *exanthema hæmorrhagicum* in which febrile symptoms ushered in the malady, with an exceedingly dry and brown tongue, and a pulse which conveyed the sensation of small, sharp vibrations with each beat —a kind of *wiry trembling*, with an extraordinary *thrill* and *hardness*, "yielding only to the withering influence of approaching death." Bleeding from the intestines and urinary system quickly supervened. These phenomena continued to spread till the whole mucous system of the patient became the seat of copious hæmorrhage. A peculiar exanthematous eruption appeared upon the skin, lasting for several days (five), and never presenting any signs of extravasation. Death followed in about four weeks. The pulse did not exceed its natural frequency (70), and there was no disturbance of the nervous system, such as headache, delirium, or want of sleep; and in the beginning of the disease the strength was not remarkably impaired; but subsequently yielded to loss of blood. The disease seemed almost exclusively confined to the arterial and capillary systems of vessels.

Treatment.—To treat this disease with success, it is necessary to ascertain the circumstances under which it becomes developed in each particular case. *Quinine* or *bark*, stimulants, *mineral acids*, *nutritious food*, and *wine*, was the treatment adopted by Cullen, Duncan, and Willan. Subsequently this plan of treatment was questioned by Dr. Parry, of Bath, who found that in his cases a full bleeding from the arm was a much more speedy mode of curing the disease. Dr. Harty, of Dublin, confirmed this principle of treatment, and was successful with liberal doses of purgatives, so as to clear out the intestinal canal completely. *Oil of turpentine*, administered in moderate and repeated doses, has also been recommended. Dr. Hardy, of Dublin, recommends the tincture of *larch bark*. He has long used it as a styptic and carminative tonic; and it is "one of the most elegant forms of prescribing a terebinthinate" (Moore). *Fifteen drop doses* of the tincture may be administered every hour, or *eight* or *ten drops three times a day*, afterwards increasing the dose according to the age of the patient and the necessities of the case.

The treatment of purpura may be comprised in the following measures:—The bowels ought invariably, and without exception, to be first thoroughly and effectually evacuated by means of senna, aloetics, or calomel and jalap. If several effectual doses of either or all of these medicines be not followed by less heat of skin, diminution of the frequency of the pulse, abatement of the internal pains, and a cleaner state of the tongue; if the spots continue to increase in number and size, and the hæmorrhagic oozings do not cease,—blood, according to age, strength, and other circumstances, may be drawn from the arm, while the patient should abstain from animal food in every form, and should subsist on boiled rice with whey, or the light subacid fruits, as grapes, oranges, strawberries, gooseberries, baked apples, or the like. His drink may consist of tamarind-water, or water acidulated with sulphuric acid. Under this plan most cases of the disease will be speedily and readily brought to a favourable termination. If symptoms of local uneasiness continue after the urgent phenomena have disappeared, leeches should be applied in the neighbourhood of the part; and it will be proper to continue the periodical and regular evacuation of the alimentary canal. When the spots have disappeared and the hæmorrhage has ceased, the constitution recruits rapidly under the gradual but cautious use of light soups and fresh fruits and vegetables (CRAIGIE).

ERGOTISM.

LATIN EQ., *Morbus cerealis;* FRENCH EQ., *Ergotisme;* GERMAN EQ., *Mutterkornbrand;* ITALIAN EQ., *Ergotismo.*

Definition.—*A train of morbid phenomena produced by the slow and cumulative action of a specific poison in a fungus peculiar to wheat and rye, and which gives rise to convulsions, gangrene of the extremities, and death, or to symptoms of ill-health.*

Historical Notice and Pathology.—Ergotism is a disease very little known in this country; but it is not unfrequent that diseased, unripe, or damaged grain of any kind, and especially *rye,* is observed to be injurious to the animal economy. *Wheat, rice,* and such-like grains are equally injurious when similarly unsound; and the most frequent form of this unsoundness consists in the development of a fungus (the *Ergotœtia abortifaciens* or *cockspur*) upon the grain, to which the name of *ergot* has been given. In this ergot fungus there is a large proportion of fixed oil (WIGGER). A morbid state is said to be produced by various other poisonous fungi, such as the *Amanita muscaria* and *citruria;* the *Hypophyllum sanguineam;* and by plants such as the *lolium temulentum* being mingled with the grain. A most characteristic phenomenon which results is a form of gangrene which follows as a specific effect of the poison in parts remote from the source of circulation. It is a species of mortification which has not been much seen in this country, but is well known, and has been frequently observed, in different parts of Europe, particularly in France, in some districts of which it has been repeatedly known to prevail as an endemic disease, where *rye* forms the principal food of the inhabitants. The *ergot* or *cockspur* in *rye* is only apt to occur after very rainy or moist seasons. In this disease the grains of rye grow to a large size, acquire a black colour, and have a compact, horny consistence. The attention of the public was first called to the peculiar mortification which follows the use of this diseased rye by M. Dodard, in the *Journal des Savans* for 1676. He described the appearance of the affected parts, and mentions that fowls fed with the grain soon died. In 1694 its frequent occurrence is noticed at Sologne, and it prevailed amongst the patients of the Hôtel Dieu of Orleans. The upper and lower extremities of those suffering from the disease "grew as dry as touchwood and as emaciated as Egyptian mummies." In 1710 it was again the subject of treatment in the Hôtel Dieu at Orleans, from its extreme prevalence in the neighbourhood. About fifty people, men and children, were admitted that season into the hospital. During thirty-three years the endemic appeared three or four times, and always in those rainy or moist seasons in which the rye contained a large proportion of the cockspur—more than a fourth. The mortification always began in the toes, and extended gradually along the foot and leg, till it sometimes rose to the upper part of the thigh. In some patients the gangrened part came away of its own accord; in others it became necessary to assist nature by amputation. In some instances death succeeded to amputation, the disease having continued to extend to the trunk of the body. It is particularly mentioned in a report on the subject to the Royal Academy of Sciences at Paris, that the rye of Sologne, in the year 1709, contained fully *one-fourth* part of the cockspur. The disease generally began in one or both feet, with pain, redness, and a sensation of heat as burning as the fire. At the end of some days these symptoms ceased as quickly as they had come on, when the sensation of extreme heat was changed to cold. The part affected became black, like a piece of charcoal, and as dry as if it had been passed through the fire. A line of separation tended to form between the dead and the living parts, like that which appears in the separation of a slough produced by the application of the cautery.

The disease prevailed in Switzerland in 1709 and 1716, and is described by Langius, of Lucerne. M. Garroud, a physician of Dauphiny, where the disease prevailed in 1709, makes some very important observations on the different symptoms apt to predominate in different individuals. Some patients suffered very violent pain, with an insufferable sensation of heat, although the part felt cold to the touch. In other patients redness, with much swelling, supervened, attended by fever and delirium. The separation of the dead parts from the living took place with excruciating pain. The gangrene was not in every instance dry. Animals were found to die of the specific gangrene when forced to swallow the diseased *rye*, for they refused to eat food containing it.

The experiments and observations of Tessier show that a given quantity is required to produce the specific effects, and that the action of the poison is cumulative.

The history of some cases of mortification of the limbs related by Dr. Charlton Woolaston, in the *Philosophical Transactions* for 1762, shows that it may occur in this country from eating *wheat* diseased similarly to the *rye;* and Sir William Wilde, of Dublin, has recorded its occasional occurrence in Ireland.

Symptoms.—The gangrenous form of ergotism is ushered in by excessive lassitude, more or less protracted, and accompanied with fever; the extremities become painful, cold, and rigid, benumbed, and almost insensible, and are with difficulty capable of movement. Severe internal pains of the limbs prevail (acrodynia), greatly aggravated by heat. It extends by degrees from the toes to the legs and thighs, and from the fingers to the arms and shoulders, when sphacelus supervenes. With the exception of slight febrile heat, the constitutional disturbance appears to be slight, and in this respect resembles scurvy. Ricker has recently described the early symptoms of a case of poisoning by bread containing *ergot.* A family of six persons partook of the bread, and all suffered from the same symptoms—namely, dryness of the throat, epigastric oppression, nauseous taste, mucous and biliary vomiting, vertigo, stupor, and diarrhœa (*New Syden. Society Year-Book,* 1861). Seeing that symptoms vary greatly in severity, probably in proportion to the amount of diseased food taken, and the poisonous nature of the particular fungus which affects it, we may have the expression of some phenomena more fully than others—for example, *acrodynia.* Under this name Chomel described a painful affection of the wrists and ankles which prevailed in Paris in 1827, 1828, and 1829. It was then so prevalent among the soldiers in the barracks of Lourcine, that 560 men were affected out of 700; and in that of Comtille, 200 men out of 500. Since 1828 no case has been recorded in the barracks or military hospitals (PARKES). In 1859 M. Barudel observed three cases in the military prison at Lyons; and in spite of negative results of the examination of the quality of the food, Dr. Parkes is inclined to believe that the cause lay there, and probably in ergotism of the flour (*Army Medical Department—Sanitary Report* for 1860, p. 358).

The general train of symptoms produced by the use of diseased grain assumes two forms—namely, the spasmodic or the gangrenous. The spasmodic form commences with a sense of tingling or itching in the feet, followed by cardialgia and similar tingling sensations in the hands and head. Violent contractions of the hands and feet follow, which seem to affect each particular joint, and the pain is said to resemble that of a dislocation. The sensations are also sometimes described as of a bruising kind; and the body is bathed in copious sweats. The symptoms intermit during intervals of two or three days of a remission at one time. Drowsiness, giddiness, indistinctness of vision, and an irregular gait are constant phenomena. Coma and epileptic convulsions are apt to supervene, which generally indicate a fatal result. An enormous appetite accompanies this train of evils. Spots like those of purpura appear on the face, and the disease rarely abates before the third week.

Treatment.—Considerable differences of opinion prevail regarding the treatment of this *dietic* disease. The cause, in the first instance, must be ascertained and removed. To obviate the effects it has already produced, the constitutional treatment must be directed to improve the state of the blood. Tonics and stimulants are to be administered after a free employment of evacuant remedies to clear out the alimentary canal completely. The chlorates of potash and of soda, with antispasmodics, tonics, and narcotics, are especially indicated. *Camphor, musk, ammonia, capsicum,* may be particularly mentioned; and the strength of the patient is to be supported by light, nourishing, and wholesome food.

DELIRIUM TREMENS.

LATIN EQ., *Delirium alcoholicum;* FRENCH EQ.,———; GERMAN EQ., *Delirium tremens*—Syn., *Säuferwahn sinn;* ITALIAN EQ., *Delirium tremens.*

Definition.—*A train of morbid phenomena, produced by the slow and cumulative action of alcohol, in the various forms in which it is used as a drink. Delirium is one of the most prominent features of the morbid state, which is otherwise characterized by hallucinations, dread, tremors of the tendons and muscles of the hands and limbs, watchfulness, absence of sleep,* *great frequency of pulse. A thick, creamy fur loads the tongue, and a cool, humid, or perspiring surface prevails; while the patient gives forth a peculiar odour, of a saccharo-alcoholic description, more or less strong.*

Pathology.—This disease has only been recognized and described since the beginning of this century. The *Experimental Inquiry* of Dr. John Percy, in 1839, illustrating the physiological action of alcohol; an inquiry into the *Physiology of Temperance*, by Dr. Carpenter; the recent *Pathological Observations on the Bodies of Known Drunkards*, by Drs. Roesch and Francis Ogston (1855); and, lastly, a most able and interesting review on the "Treatment of Delirium Tremens," in the *Brit. and For. Med.-Chir. Review* for October, 1859, are contributions which have placed on a more sure foundation our previous theoretical information regarding morbid states which follow the persistent use of alcohol.

The term *alcoholism* is used to denote various symptoms of disease attending morbid processes of various kinds which are capable of being traced to the use of stimulants containing alcohol. The immediate effects of *intemperance* in the use of alcoholic fluids, the nature of *delirium tremens*, and of *spontaneous combustion*, may be embraced under the general designation of *alcoholism*. This term is used in the sense analogous to that in which we use the terms *mercurialism*, *ergotism*, *narcotism*, and the like;—the agents inducing these specific states acting after the manner of a cumulative poison. The progress of modern science has distinctly demonstrated the poisonous action of alcohol; and an account of the nature of delirium tremens, as well as the grounds on which its treatment must be based, are now alike founded on this knowledge. Tiedemann and Gmelin in 1820, and Majendie in 1823, detected alcohol by its odour in the blood. The fluid found in the ventricles of the brain had also been observed to have the smell, the taste, and the inflammability of gin (SIR A. CARLISLE). In 1828 it was theoretically advanced by Leovèille that *delirium tremens* consisted in an exalted state of the vital powers of the brain, excited by molecules saturated with alcohol absorbed from the surface of the stomach and bowels, and carried into the current of the circulation. Now it is a matter of fact, determined by direct experiment, as well as by casual observation, that alcohol is absorbed directly into the circulation, and is capable of acting as a direct poison upon the nervous tissue through which the infected blood circulates. Alcohol has been found in the blood, in the urine, in the bile, in the fluid of the serous membranes, in the brain matter, and in the liver (Percy, Ogston). Its odours can be easily detected in the breath, and the habitual immoderate drinker exhales a distinct alcoholic and saccharine odour more or less strong. His clothes at last acquire a spirituous aroma, every part of his body being long thoroughly imbued with alcohol (Craigie). This odour is generally so well expressed in cases of *delirium tremens* that a place has been given to a statement of the fact amongst the characters embodied in the definition. Dr. Percy's experiments directly support these statements, and prove at the same time the great rapidity with which alcohol passes into the current of the circulation. He injected strong alcohol into the stomachs of dogs; and within two minutes after completing the injection, their respiratory and cardiac movements ceased; the stomach was found nearly empty after death, whilst the blood was highly charged with alcohol.

I once had an opportunity of examining the body of a person who for many years had been in the habit of drinking daily a large quantity of brandy. He died of *typhoid asthenia,* with characteristic degeneration of nearly every important organ of the body and of the blood-vessels. The fluid collected from the cavities of the brain, consisting of serum and some blood, contained 2·6 *per cent.* by volume, and 2·1 *per cent.* by weight, of alcohol. This quantitative analysis was made for me by my friend Dr. F. S. B. F. de Chaumont, with Giessler's vaporimeter.

NB

The pernicious effects of the continuous use of alcoholic stimuli on the organs and tissues of the body have been deduced from a careful study of the morbid appearances, of *a chronic kind,* met with in the bodies of individuals known to have lived intemperate lives, and who *had perished suddenly* from the effects of accident, suicide, or homicide, and while apparently in ordinary health and activity. The extent of the chronic changes in the various organs of these individuals is found to have been far in excess of what could have been reasonably looked for in a like number of persons of the same age, and of temperate habits, suddenly cut off while apparently in average health and vigour. The *cumulative* effects of long-continued intemperance have been clearly proved by Dr. Ogston's observations; and the results of his *post-mortem* inspections, on the whole, support the conclu-

92 (1) Brain
64 (2) ~~Liver~~ Lung
(3) Liver
(4) Ht
5 Kidneys
(6) Al canal

Chronic

90

sions which have been arrived at on *theoretical grounds* as to the injurious effects of alcohol in excess. The following statements contain a summary of these results:—(1.) *The nervous centres* present the greatest amount of morbid change, the morbid appearances within the head extending over 92 *per cent.* o those examined. By this observation the theoretical remarks of Leovèille, Craigie, and Carpenter are clearly established. (2.) *The changes in respiratory organs* succeed in frequency those of the nervous centres, yielding a *per centage* of 63·24 of those examined. (3.) *Morbid changes* in the liver are next in order of frequency, and are due to enlargement, granular degeneration, the nutmeg-like congestion, and, lastly, the fatty state. (4.) Next to changes in the liver come those in *the heart and large arteries.* (5.) Next are those of the kidneys. (6.) Least frequent of all are morbid changes in the *alimentary canal.*

Two orders of changes may be observed to result from intemperance in the use of alcoholic fluids—namely, one set of long duration, or which at least must have taken some considerable time before they could be completed; another set of shorter duration, and which probably are more closely connected with the immediate symptoms which precede the fatal event.

The abnormal changes in the cranium, the substance of the brain, its convolutions and cerebral ventricles, all indicate the prolonged action of a morbid poison. The prolonged action of the alcoholic poison on the cranial contents is to produce induration of the cerebral and cerebellar substance in by far the largest number of cases, coincident with an increased amount of subarachnoid serum; while the steatomatous degeneration of the small arteries leads to *atrophy* of the convolutions and *œdema* of the brain.

When spirituous liquors are introduced into the stomach they tend to coagulate, in the first instance, all albuminous articles of food or fluid with which they come in contact: as an irritant, they stimulate the glandular secretions from the mucous membrane, and ultimately lead to permanent congestion of the vessels, to spurious melanotic deposit in the mucous tissue, and to thickening of the gastric substance. By the veins and absorbents of the stomach the alcohol mixes with the blood, and immediately acts as a stimulant to all the viscera with which it is brought in contact. The functions of the brain are at once stimulated, and ideas

Richardson – Med. Times [illegible] Dec 10/64. shows that alcohol ethylic when producing profound intoxn in birds reduces their tempre 5½–6 deg F, [illegible] 2½–3. & when introduced in small but repeated quantities, so as not to produce any of the stages of true intoxn, in small mammalia it reduces tempre 1½ deg

follow in more rapid succession; the liver is excited to secrete an excess of sugar, by the immediate action of the stimulant on its tissue (DRS. HARLEY and BERNARD). The flow of urine is excited in a similar manner.

MB

In these effects it is impossible not to recognize the operation of an agent most pernicious in its ultimate results, when indulged in habitual excess; but most valuable as a remedial agent, when its action is understood and appreciated (consult Dr. Anstie's valuable work on *Stimulants and Narcotics; their Mutual Relations*). The mere coagulation of the albuminous articles of food and fluid is very different from that effected by the gastric fluids, and tends to render the articles more difficult of solution by the gastric juice.

~~In these facts~~ it is impossible not to recognize that alcohol being absorbed, a double series of morbid results ensue. On the one hand, a train of phenomena are induced partly of a *chemical* nature and partly *physiological* or *vital*. The general nutrition of the body suffers; and a bad state of health is at last induced, of a peculiar kind, sometimes described as the "*drunkard's cachexia* or *dyscrasia*." This state of the system is characterized by positive irritation, which very soon succeeds to the intemperate use of alcohol, and which is manifested in a variety of ways; sometimes by an unnaturally voracious appetite; but those who over-indulge in the use of such stimuli subsequently suffer a total disrelish for food; they become unable to eat, and dyspeptic symptoms of various kinds betray the irritable state of the alimentary canal, such as stomach-ache, the frequent generation of gases, water-brash, heartburn, squeamishness, morning vomiting, and palpitations of the heart. A constipated condition of the intestines, attended with deficiency in the power to expel their contents, is very soon established, and sometimes ascribed to the deficient secretion of bile, which is known not to be secreted in due quantity; and there is every reason to believe, although the fact is not proved, that its quality is deteriorated. Its functional agency on the food and fluids in the intestines is therefore diminished.

If we follow the course of alcoholic absorption through the vascular and pulmonary system, it is found unquestionably to *retard* the motion of the blood, while it produces a temporary increase in the action of the heart, and a congestion of the whole system of the pulmonary capillary vessels. Respiration is thus, in the first instance, rendered from four to six times more frequent per minute than it otherwise is; and various symptoms of accumulation of blood within the chest, and pulmonary congestion especially, are apt to occur. A short, tickling cough is a most constant phenomenon. Dr. Craigie remarks that all the spirit-drinkers whom he has ever seen or known have been either subject to chronic cough or dyspnœa, or have laboured under chronic, dry bronchial disorder, with asthma. That the use of spirituous liquors ultimately retards the motion of the blood in the vessels is known by experiments on the lower animals, and by pathological observations. Thus far we have a morbid condition induced which is highly favourable to the accumulation of fat in the blood, and such an accumulation has been proved to take place. It has been shown by Becquerel and Rodier that fat increases in the blood, in most acute diseases, when the biliary secretion is retarded, and when a scanty amount of food is taken. These are the very conditions which obtain in alcoholism. It is in cases of undoubted drunkenness that fats have occurred in the blood in such obvious quantity as to leave no doubt of its presence. In such cases a milky character is imparted to the serum—a condition which may be recognized by simple inspection; while a microscopic examination and treatment with ether will establish the diagnosis, and distinguish the fat from colourless blood-corpuscles, or from molecules of albumen. Slighter degrees of this condition are altogether physiological, and are met with during the period of digestion, after eating substances rich in fat (A. Buchanan, Vogel). But the extreme degrees of this condition have been especially met with in drunkards. J. Frank regards the white and fatty blood as having its origin in the abuse of alcoholic drinks (*Hannoversche Annalen*, 1847, p. 283, quoted by Vogel). Dr. Adams (*Trans. Med. and Phys. Society of Calcutta*) mentions the case of a sergeant at Fort-William who went to bed drunk, and was found dead in the morning. The vessels of the brain were greatly distended with blood, and oil was seen floating in it. Rayer relates the case of a man who, after drinking largely of punch, destroyed himself by the fumes of charcoal. The blood and the urine contained globules of oil. Serules, of Strasbourg, records similar phenomena. Thus, it is shown by abundant testimony that the blood becomes surcharged

× $C_2H_6O + O_2 = C_2H_4O_2 + H_2O$

$C_2H_4O_2 + 2O_2 = 2CO_2 + 2H_2O$

with unchanged and unused material, and contains at least thirty *per cent.* more of carbon than in the normal state. NB The order of events by which this state comes about is somewhat as follows:—Alcohol is directly absorbed by the blood-vessels without undergoing any change or decomposition. Part of it is eliminated very slowly as alcohol by the lungs, by the liver, and by the kidneys; but appears to tarry in largest amount in the liver and in the brain (PARKES). Another portion is decomposed. Its hydrogen enters into combination with oxygen to form water, which, with acetic acid, having been produced, carbonic acid and water are formed. Oxygen is thus diverted from its proper function, the exhalation of carbonic acid at the lungs is diminished both absolutely and relatively, and less urea is excreted by the kidneys than is consistent with health; but the pulmonary aqueous vapour is not lessened (BÖCKER and HAMMOND, quoted by PARKES). The water of the urine is diminished, the chlorine is greatly lessened, as well as the acids and bases. All the evidence, therefore, points to the effect of alcohol as causing the retention of substances which ought to be eliminated; NB and this retention of the effete matter is still more intensified by the stimulant action of alcohol increasing for a limited time the frequency of functional acts, followed as it is by a corresponding depression. In this way impaired health is soon brought about, tending to wasting of the tissues generally; and so long as any alcohol remains in the blood *as alcohol*, a certain toxic or poisonous effect continues to be produced upon the nervous system through which the poisoned blood circulates. If a constant supply of the alcohol is kept up, the phenomena of *alcoholism* become chronic or persistent; and acute paroxysms, generally in the form of *delirium tremens*, supervene, which is at once the most common and the most prominent evidence of *alcoholism*. In other instances the degeneration of several vital organs generally may become so excessive that death follows by *asthenia*, or with typhoid phenomena ending in coma.

When mixed with blood out of the body, spirituous liquors cause more or less coagulation according to their strength and concentration; and when applied to the blood-vessels in the transparent parts of animals, they can be seen to produce the same effects. The congestion that constantly exists in the mucous membranes of the lungs and stomach is evidence of the retarded

[illegible]
produce motor — but not muscular relax. a absolute [illegible]
a few muscles tremor occurs spontaneously, but on the [illegible]
excited by a touch at any time — In the intervals when
the tremors are absent, there is frequent twitching of
muscles - The tremors themselves are not positive
muscular contractions, but rather vibrations through the whole

motion of the blood. The fact that hæmorrhoidal swellings are always aggravated by the use of alcoholic fluids is the result of retarded motion of the blood in the hæmorrhoidal vessels. When death occurs from poisonous doses, either in animals or in man, although the dose is at first followed by increased frequency of the pulse, yet in a short time the pulse becomes rapid and small; while the extremities become cold, and the power of generating heat is suspended in proportion as the blood progresses slowly and more slowly through the pulmonary capillaries. These effects upon the lungs must be regarded as of a toxic kind; and this specific toxic action is not less obvious on the brain. Its nerve-substance becomes poisonously affected—a condition which seems to constitute one of the most necessary antecedents in the causation of *delirium tremens*.

The effects produced on the medulla oblongata tend to sustain this toxic effect upon the lungs. The brain and the lungs in this respect act and re-act on each other. Death may ensue in various ways, but generally by coma, asphyxia, syncope, exhaustion, or epilepsy.

In the case of habitual spirit-drinkers there is thus constantly going on a temporary stimulus and quickened motion of the blood through the vessels, especially manifested by cerebral, thoracic, and hæmorrhoidal phenomena, followed by a corresponding depression and tendency to stagnation of the blood in the capillaries of all the internal organs, especially in the membranes and the lax areolar tissues of dependent parts.* The essential nature of *delirium tremens* is associated with the loss of cerebral power, evinced especially in the want of control over thoughts, emotions, and muscular action, consequent on the direct influence of the alcoholic poison. Disturbances of function, depression, and debility are the attendant phenomena. The feeble but rapid action of the heart, the tremulous, undecided action of the muscles, and the terror-stricken and agitated mental state, betoken the depressed condition of the living functions. The amount of phosphates in the urine, as determined by Dr. Bence Jones, is diminished, while the proportion of the sulphates and of the urea is greatly increased. The nature of the morbid lesions found in such cases has been already indicated. The disease has been variously named the muscular system, & are connected with extreme want of true contractile power - they are not produced by Methylic & Ethylic Alcohol -

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* The influence of alcoholism in causing progressively degeneration of the individual and of the race has been considered at page 144.

brain fever of drunkards, dipsomania, or *delirium tremens*, by which latter name it is more frequently known and described in this country.

Symptoms and Course.—The disease has been said to become developed under two sets of circumstances—namely, according as the patient has been continuing his potations, or after he has suddenly abandoned them. But its occurrence under this latter circumstance is now known to be nothing more than a coincidence; and of all the errors in popular acceptation connected with the malady, none is greater than that which affirms the exciting cause of a paroxysm of *delirium tremens* to be a sudden stopping or withdrawal of the accustomed quantity of stimulants. The ceasing to drink depends on the commencement of the disease (GAIRDNER). NB There are some who are constantly taking small quantities of spirits, and who, although they never get completely intoxicated, yet sometimes exceed considerably their accustomed allowance, and continue to do so for some time. The symptoms of *delirium tremens* generally appear in them from the second to the eighth or ninth day after a protracted debauch, and are by some pathologists divided into three stages. The first stage, (1) according to Dr. Blake, is marked by a peculiar slowness of the pulse, by coldness and clamminess of the hands and feet, by general debility, by nausea and vomiting in the morning, and by frightful dreams at night. Very moderate exertion of body causes the patient to perspire profusely, and anything which suddenly affects his mind throws him into a tremulous agitation. The tongue is tremulous and furred, the hands shake, and he is greatly depressed in spirits, sighs frequently, is anxious about his affairs, and is either restless or watchful. These symptoms last from 24-48 hrs twenty-four to forty-eight hours.

The second stage commences by a hurried and anxious manner, (2) by great excitability of temper, by a small, accelerated pulse; some heat, perhaps, of the surface of the trunk, but accompanied with the coldness and clamminess of the extremities. The tongue is sometimes clean, but often brown and dry, and the patient delirious, suffering from various mental illusions and alienations. In general the delirium is melancholy, and has reference to his usual occupation and habits, or to some difficulty in his domestic affairs. He sometimes sees flames or hears voices talking to him, or as soon as he shuts his eyes he sees people passing under the bed-clothes. In short, he sees objects and sights in situations in which they are not, and which have no real existence; or betrays the most dreadful alarm at hideous objects which he imagines are threatening him with immediate destruction. Restless and sleepless, he moves his trembling hands horizontally over the bed-clothes, as if seeking for something. In general he is harmless and easily controlled; but in some instances he is violent, mischievous, and requires to be restrained. This stage generally 3 - 7 Days lasts from three or four days to a week, when the third stage (3) commences by the patient falling into a sound sleep and gradually recovering, or a fatal collapse comes on, which finally and shortly closes the scene. Without reference to stages of the disease, the following is a general description of its symptoms.

There is always more or less derangement in several other functions besides the brain. The patient is generally void of all appetite; or he may be squeamish, and vomit at intervals. Sometimes he is thirsty, and calls loudly for liquor of various kinds; but often he is indifferent to the sensation of thirst. In several instances great aversion, and even dread, of all food and drink has been evinced; and it has been impossible to persuade the patient to partake of either. The tongue is at first covered with moist white, grey, or slate-coloured fur, and when protruded it is tremulous. The bowels are constipated, and less sensible than in the state of health to the action of medicine. When they are acted upon by remedies, the discharges are very dark-coloured, the first generally consistent, the latter liquid, dark, and offensive. There are generally fulness and distension, and not unfrequently tenderness and pain, in the epigastric, umbilical, and right hypochondriac regions; and sometimes the two hypochondriac regions give the patient the sensation as if they were drawn tightly together. The skin is bathed about the head and neck with a clammy, unctuous, cold moisture; but elsewhere, and especially at the feet, it is cold, dry, and imperspirable.

The pulse varies from 96 to 110 or 120, sometimes 130; and though sometimes small and oppressed, is often full, voluminous, and throbbing. The carotid and temporal arteries beat most violently; those of the wrist less forcibly; and the anterior and posterior tibial arteries pulsate feebly enough. The action of the heart is in general unusually violent, and the cardiac beat is diffused over the whole chest. The respiration is occasionally panting and irregular, but not otherwise morbid. Restlessness is extreme. The patient is in constant agitation of mind and body; speaks almost incessantly, yet seldom adheres above a minute to one subject, and is constantly changing place and looking for some new object. He cannot sleep, and dreads to be left alone, from the apprehension of spectral visitations. With this restlessness the upper extremities, and especially the hands, are in constant tremulous motion, such that they cannot be kept for two seconds in the same position, nor can the pulse in many cases be accurately numbered at the wrist. Though this tremulous motion of the arms, wrists, and hands is very general, it is not constant; and instances of the mental disorder, agitation, spectral illusions, and sleeplessness have been observed to take place without any such kind of tremors. They are very rarely, almost never, seen in the young or middle-aged to any very great extent, or those whose muscular motions are not otherwise unsteady; and are seldom well marked in first attacks of the disease. Such tremors are principally observed in the cases of confirmed dram-drinkers, whose motions are always unsteady in the morning and early part of the day, until they take a certain proportion of their habitual stimulus (CRAIGIE).

After symptoms of restlessness and sleeplessness have continued for three or four days, the patient may fall into a sound, unbroken slumber, which lasts for some hours. The paroxysm thus works itself out in a definite time in uncomplicated cases; and sleep occurs simply as the natural, the favourable termination of the disorder. It occurs as the *result* of the paroxysm having run its course, and of the nervous system having lapsed into an improved condition, and must not be regarded as the *cause* of those favourable conditions, (Reviewer in *Brit. and For. Med.-Chir. Review*, l. c.) On the other hand, the symptoms may pass into a state of *coma vigil*, with constant muttering delirium, *subsultus tendinum*, and picking of the bed-clothes, the pupils become contracted, the muscles of the face and jaw are moved incessantly, and death may ensue from prolonged coma or convulsions. The duration of the paroxysm varies from three, four, or seven days, and a favourable or fatal termination may be looked for in from three to five days.

Diagnosis.—*Delirium tremens* is to be distinguished from

76) 700 (9.2
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typhus fever, and from paralysis agitans, by the previous history of the case, and by the symptoms.

Prognosis.—It is hardly determined what is the proportion of recoveries to deaths; but unquestionably three persons out of four do well. A paper in *The Indian Annals of Medical Science* for 1855, by Dr. Macpherson, notices the great discrepancy in the statistics of writers on *delirium tremens,* with regard to its frequency in both sexes, and to the mortality of the disease. He attributes this chiefly to a want of due classification. Calmeil states the rate of mortality at 5 *per cent.,* Bougard at 19 *per cent.* The most accurate records to be got are those regarding the British troops at different stations. The late Sir Alexander Tulloch, in his report for 1853, gives the following *per centages* of mortality among them:—

Great Britain, infantry,	17·6
,, cavalry,	13·8
Bermuda,	15·0
Canada,	7·94
Gibraltar,	13·6
Malta,	8·8
Nova Scotia,	9·1

A return of admissions and deaths from *delirium tremens* and *ebrietas* in the General Hospital in Calcutta, from 1848 to 1852, and another of admissions and deaths from the same causes in the Medical College Hospital, during 1851, 1852, and 1853, give some important results as follow:—

That *delirium tremens* occurs in women and men in the proportion of one to twenty-five; but that this difference is due to the difference of habits rather than of sex.

That in regard to age the ratio is as follows:—

	Cases.	Deaths.	Per cent. of Deaths.
Ages from 20 to 25,	34	4	9·1
,, 25 to 30,	66	16	24·2
,, 30 to 35,	48	11	22·9
,, 35 to 40,	76	7	9·2
,, 40 to 45,	62	6	9·6
,, 45 to 50,	23	4	17·3
,, 50 to 60,	7	—	—
,, 60 to 65,	5	1	—

The greatest mortality is between the ages of twenty-five and forty, which is confirmed by the analysis of another series of

Vide a Lecture of Murchison Lancet Oct 29/70
On Treatment

sixty-four fatal cases. The *per centage* shows that there is no uniformity in the proportion of deaths to the number of cases.

There is no evidence to show that the season of the year exerts a definite influence on the occurrence of the disease, whereas the mortality very palpably varies with the temperature—it being more than double in the eight hot months as compared with the four cold months. in India

The apparent cause of death was as follows:—Thirty-three by exhaustion (often with coma); eighteen by coma; eleven by fits (probably apoplectic, called sometimes epileptic); one died on the night-stool; one was found dead in bed.

Convulsions occurred in at least twenty of the above cases. One distinct case of paroxysmal *opisthotonos* occurred in a musician, who during the intervals was able to sit up and whistle tunes.

Treatment.—From the nature of the disease as now described, as well as from the dire results of experience, it is now clearly established that the indications for treatment are,—(1.) The elimination of the poison; (2.) The sustenance of the patient during this period. The two most fatal errors which can be committed in the treatment of *delirium tremens* are either to *bleed* the patient or to give him *opiates*. The greatest number of cases of those treated by opiates are apt to terminate by convulsions and coma (MOREHEAD, PEDDIE, LAW, CAHILL, LAYCOCK). If it be true, also, that opium and alcoholic stimulants singly are to be deprecated in the treatment of *delirium tremens, à fortiori* in their combination there is a twofold danger; and alike in tropical as in temperate regions it is a course of treatment attended with much hazard, and which, when systematically followed, is certain of leading to unfortunate results (See Morehead's *Researches on Diseases in India;* also, "Notes on Treatment of Delirium Tremens," by W. Hanbury, 33d Regiment, in *Madras Quarterly Journal*, July, 1863).

The strength must be supported by diet of the most nutritious kind, in a fluid and mild form, such as yolk of egg, soups, and the like: food should be given in small quantities, and often. Beef-tea, spiced soup, and egg-flip, are each to be commended at different periods of the day.

Arrangements should be made so that the patient does not catch cold; and if he continues to digest food, the danger is much

Begin treatment. with an active purge
Cut off all stimulants

K Br. Chloral 3j every 2 or 3 hrs till sleep procured

diminished. The danger in the first instance is from exhaustion; and careful nursing is above all things necessary, so that protection may be adequate and the food adapted to the state of the digestion, which is always feeble. The disease must be treated as one spontaneously curable; not by withholding remedies, but by using them in strict subordination to good nursing and carefully adjusted diet and regimen (Ware, Hood, Peddie, Laycock, W. T. Gairdner). Active specifics for *delirium tremens* appear to be founded on the idea that the disease is one nominally of high mortality. Hence the enormous doses of *digitalis* (Jones) and of *Cayenne pepper* (Kinnear); but before resorting to the use of such remedies as *digitalis*, it will at least be judicious practice to adopt such means as are calculated to restore the powers of nature—namely, nutrients and rest; while the stimulus of such a spice as *Cayenne pepper*, given in the soup, on the atonic stomach, will have a favourable influence on absorption.

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In some cases purgative remedies are indicated from the first. "These cases are known by the flushed, bloated appearance, the very foul tongue, the *mawkish*, peculiar odour of the breath, the fetid discharges from the bowels, and the history of a recent surfeit of eating as well as drinking" (W. T. Gairdner, *Clinical Medicine*, p. 271).

Opium may be administered with safety and advantage only in protracted cases, provided the quantity given in twenty-four hours is never allowed to exceed the full dose which would be considered safe for a healthy person of the age and sex of the patient. Where it appears to be indicated in protracted cases, it ought to be pushed as rapidly as possible for two or three doses, while its effects are carefully watched. Its use must be discontinued for at least a good many hours, as soon as a full maximum amount of ʒiss. to ʒii. of the tincture in all has been reached, or even sooner if the pupils have *become at all considerably contracted during its use.* This remedy should always be given in the fluid form, otherwise it is apt to accumulate in the bowels, owing to the weakened state of the digestion; and a laxative, or even a purgative, should be alternated with opium, followed by a bitter tonic, which always operates favourably in lingering cases of nervous and dyspeptic exhaustion. Narcotics are thus only safe in *delirium tremens* when they are given with the object of aiding and seconding the natural cure of the disease, employed in

In D. T. whenever the urine contains albumen as result of recent congestion or old disease of kidneys opium is almost certain to fail or even prove injurious – If albumen absent give opium without fear – Murchison L. C.

moderate doses, and given only at the later stages. The *heroic* use of them, as heretofore too often advocated even by the most eminent physicians, is now recognized as a treatment which merely substituted *narcotic* poisoning for *alcoholism* or *delirium tremens*.

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Nov 26 by [illegible]

LEAD PALSY.

Latin Eq., *Paralysis ex plumbo;* French Eq., *Paralysie saturnine;* German Eq., *Beilähmung;* Italian Eq., *Paralisi litargirosa.*

Definition.—*A series of morbid phenomena induced by the absorption of the salts of lead contained in solution in drinking-waters, or in various foods and drinks, or conveyed into the system through the integuments of those who are in the habit of handling the soluble salts of lead; or through the pulmonary mucous membrane of those exposed to the influence of vapours containing lead.*

Pathology.—The theory of this disease is, that the lead being absorbed, produces a peculiarly painful affection of the alimentary canal, termed *lead colic*, or *painters' colic* (eq., *colum ex plumbo*). It may also affect the muscles of the extremities, producing palsy; and finally it produces ulceration of the gums and alveolar processes, accompanied by a peculiar blue line, which was first pointed out by Dr. Burton, of St. Thomas's Hospital. This blue line is seen along the free margin of the gums, but is absent where a tooth or stump is wanting. To this the name of "blue gum" has been given. A stain, also from lead, sometimes affects the conjunctiva.

The fact of the lead being absorbed and mingled with the blood is demonstrated by the circumstance that lead has been obtained from the coats of the stomach of a dog poisoned by lead, even as late as a month after poisoning. Again, MM. Duvergie and Guibourt have detected lead in the brain of the human subject, and Dr. Budd has detected it, not only in the human brain, but also in the muscles. Many pathologists are inclined to believe that the blue line observed in the gums of persons poisoned by lead is owing to the presence of lead in some peculiar state of combination, as with some of the constituents of the tartar of the teeth (Tomes); and from the observations of the late Dr. George Wilson, it appears that there are various tissues of the body for which lead has an affinity, and that it is more apt to be found in some organs than in others. The stomach and cœcum of a pony that died a fortnight after being removed from the sources whence lead was received into its body through the ingesta, having been carefully analyzed by this able chemist, it was found that, while the contents of these viscera did not contain the metal, the substance of their tissues yielded it in small but manifest quantity. In a mare dying under similar conditions the following organs were examined:—(1.) A part of the lungs; (2.) A part of the heart; (3.) A part of the large intestine and contents; (4.) A part of the stomach and duodenum; (5.) The spleen; (6.) One kidney; (7.) A portion of the liver. The spleen yielded the most abundant and most deeply coloured precipitates; while the intestinal canal gave the faintest indications. Next to the spleen the liver yielded most, afterwards the lungs, then the kidney, next the heart, and least the intestines.

The general result of these analyses went to show,—*First*, That in cases of slow poisoning with lead, the metal comes to be diffused through the entire body, and exerts its poisonous action, though in an unequal degree, on every organ; and *Second*, That lead having once entered the body, leaves it again very slowly, so that long after an animal has ceased to receive lead in its food or drink, or by any other medium, we may expect to find the metal in its tissues; and the restoration to health is always protracted. The lead passes off by the urine sometimes in large quantities, but very slowly (PARKES). Fletcher found in the urine of a man with lead colic no less than 4·8 grains of metallic lead in 100 grains of solid matter of the urine (*Dublin Med. Press*, 1848); and Dr. Parkes records a case in which the last exposure to the influence of lead was on the 20th December, 1852, and lead was found in the urine before treatment commenced on the 16th June, 1853, and the blue line was still perceptible below the edge of the lower gum.

Colica Pictonum rarely causes death. De Haen opened many persons that died from lead poisoning, and found in all a constriction of the colon, and in a certain number a similar affection of the cœcum. Merat opened seven cases, and observed a similar appearance. Dubois de Rochfort says that he found in two cases intussusception of the intestines; but Andral examined five

CROSS HOSPITAL

cases, Louis one case, and Martin another, without finding any morbid appearance.

Mr. Hunter had an opportunity of examining the state of the muscles of the palsied hand and arm of a painter who died of a broken thigh in St. George's Hospital, and found them all of a cream colour, being probably in a condition of fatty degeneration. In the paralysis arising from the poison of lead the tissues of the muscles and nerves are early affected, and at a subsequent period the nervous centres became implicated. The muscles seem to be first affected, and through them the nerves participate in the contamination, which gradually advances to the nervous centres in the severer forms of the disease. This is shown by the fact that local paralysis always precedes, and generally for some considerable time, those phenomena which indicate disease of the nervous centres, and which show that contamination of the system has been great. The evidence now is also abundant which proves that it is lead existing in the affected tissues which thus contaminates and impairs their function. The morbid appearances in the brain and spinal cord are generally such as denote imperfect or depraved nutrition of those centres. The brain is pale and soft, and its convolution wasted, the *sulci* between them wide, and sometimes patches of white softening are to be seen in the hemispheres; and this seems to be more particularly the case in those who have had paroxysms of an epileptic nature, and in whose brains lead has been detected (TODD).

The introduction of lead into the system has taken place in a great variety of ways. In France the pernicious effects were wont to occur from putting a lump of litharge into the *vin gâté*, to cover its acidity and render it saleable; and from this having been practised to a great extent by the Pictones, or inhabitants of Poictou, the disease has been named *Colica Pictonum.* In the cider counties of Great Britain this disease formerly existed to a great extent, and has been termed Devonshire colic, or *Colica Damnoniensis.* The impregnation of cider with lead in this country was generally the effect of accident, and arose from the troughs in which the apples were crushed having the different pieces of stone of which they are composed clamped together with iron, and fixed by melted lead. In some districts it was the practice to line the entire press with lead, or to tip them with that metal. It was a custom, also, almost universal, to make the upper part of the boiling vessel of lead; while some growers, in managing weak ciders, put a leaden weight in the cask to sweeten the liquor. From these and perhaps other causes, Sir George Baker found the cider he examined to contain four and a half grains of lead in eighteen bottles, or a quarter of a grain in each bottle. In the West Indies lead poisoning appears to have been produced by using leaden worms to the stills, by which the rum became impregnated with this metal. There are many other minor sources of poisoning by lead; as keeping pickles or preserves in glazed earthen vessels, and colouring confections with preparations of lead. The still and other machinery used in the distillation of fermented liquors being now constructed of metals so combined as not to be acted upon by acid fruits or sugar, diseases from the action of lead are no longer so common as they were wont to be, but are confined principally to labourers in the lead manufactories and to painters. The use of paint where lead exists is the most common source of its absorption in this country; and hence house painters are those most frequently affected. The paint called "flatting" (or that which is mixed with a large amount of turpentine, so as to give a *flat*, *dead*, or *non-glistening* surface) is the most injurious to the workman. The turpentine, readily passing off by evaporation, carries with it a small supply of lead, which is constantly and gradually inhaled, or it is left on the skin to be absorbed, or mixing with saliva, it gets into the stomach. By one or all of these ways the system becomes affected, first through the circulation of the blood, and subsequently by the constituent tissues of the organ combining, in some form or other, with lead, which is thus deposited in them.

All ages, both sexes, and all classes are liable to the poisonous action of this metal; but the workers in lead have been at all times the greatest sufferers. Women in this country often suffer from lead colic, but it is rare to find them paralytic; men suffer both from the colic and the characteristic palsy. [illegible]

Symptoms.—The quantity of lead necessary to produce its specific results, or the time it takes to accumulate in the system when introduced, is not determined; and both the dose and the time varies greatly in different individuals. Sometimes all its most pernicious effects are produced by one dose taken by the mouth; and then again, if introduced by the skin, months, and even years, may elapse before the system is laid under its influence. As a general rule, however, a much smaller dose will produce colic than is necessary to produce palsy.

When the dose is of such intensity as to produce *colica Pictonum*, the symptoms do not differ, except in being of greater intensity, from those which mark ordinary colic. There is the same dragging and twisting pain, and the same relief by pressure; the same absence of fever; the same unhurried pulse; the same constipation, only more obstinate; and, in the worst cases, the same vomiting. Andral, who treated upwards of 500 cases at La Charité in the course of eight years, says it is not strictly true that the pain in lead colic is always diminished on pressure; for in the greater number of cases pressure neither augments nor diminishes the pain, while in some cases the sufferings of the patient are increased by it. He also says it is as common to find the abdomen distended with gas as to find it drawn in, and the *rectus* muscle strongly contracted on both sides. The symptoms peculiar to this form of colic are, occasionally an attack of epilepsy, and an ulcerated state of the mouth, accompanied by a blue line on the dental edge of the gum—a discovery which the profession owes to the careful observation of Dr. Burton.

The duration of the constipation which attends *colica Pictonum* is very various. Three or four days may elapse before a stool is procured, and when the case is early submitted to medical treatment, seldom more than a few hours; but fifteen days have been known to elapse without a stool. As soon as the bowels act, the great severity of the disease is mitigated; every symptom is gradually relieved, and the disease generally terminates within a week.

But when palsy is the result of the absorption of lead, a painful state of the arms often precedes it, as well as repeated attacks of the characteristic *colic*. The nerves of the forearm and hand become first affected, and the affection is in general limited to the upper extremities, the extensor muscles of the hands and fingers become paralyzed, so that when the arms are stretched out, the hands hang down by their own weight, causing what the patients term "*wrist-drop.*" The disease may be sometimes seen limited to one finger. More commonly, however, it affects the whole arm, and sometimes so completely that the patient can execute no movement with it; and when lifted up, it falls like an inert mass. Sometimes the extensor muscles of the limb are alone affected; and in this case the hand is often strongly closed by the powerful and unresisted action of the flexors. When the case continues for a few weeks, the posterior surface of the fore-arms (where the extensor muscles are situated) is rendered quite concave, from atrophy and consequent shrinking of the muscles. The arm loses its plumpness, and even the interosseous membrane may be felt. The muscles of the ball of the thumb are also in a similarly wasted state. In general both arms are palsied, but not equally so, one being slightly more affected than the other. Supposing both sets of muscles to be equally palsied, the patient usually recovers the use of the *flexors* before that of the *extensors*, so that he can carry a weight hanging in his hand before he can shave himself. This restoration of the lost power is usually accompanied by more or less pain. The duration of the palsy under any treatment is always long, and often lasts many months, and in some cases years. Both colic and palsy may occur an indefinite number of times. When epilepsy is produced, the fit does not differ from epilepsy due to other causes.

Diagnosis.—The colic of lead poisoning can only be distinguished from ordinary colic by the history of the case, and by the blue line on the dental edge of the gums, but which is present only where the teeth or their stumps are in the alveoli, and ceases where a tooth is completely wanting.

The palsy is to be distinguished from cerebral paraplegia by the history of the case, by the integrity of the intellect, and by the blue line on the gum. A most important means of diagnosis in paralytic affections is the electric current properly administered. The excitability of the muscles is always much diminished in paralysis from lead, as Dr. Althaus clearly shows, and often it is entirely lost. Such is the case, not only when the muscles are atrophied, but when the bulk of the muscles is only slightly diminished; and even after the voluntary movements have regained their former power, the excitability of the muscles to the electric current still remains impaired. The relation of the muscles to the stimulus of Faradisation helps in doubtful cases to establish the diagnosis, as the excitability of the muscles is always either lost or diminished in lead palsy, whilst it is normal in spontaneous paralysis. *Therefore, when the muscles of a paralytic limb move well under the influence of the electric current, we may fairly conclude that there is no lead in the system* (Althaus *On Paralysis, Neuralgia, &c.*, p. 72).

NB

℞ Calomel gr v
Pulv Jalapæ gr xv
Pulv Opii gr i

Prognosis.—The termination of lead colic, except where the dose has been in such excess as to produce death in a few hours, is always favourable; and those cases which prove fatal are generally such as have been exposed to the cumulative influence of lead for a long time, and who have been intemperate.

The palsy does not appear greatly to affect the health of the patient; but in some cases it has hitherto not been cured or relieved. In general, however, the patient recovers, although perhaps not completely. Drs. Garrod and J. W. Begbie have satisfactorily demonstrated that lead poisoning of the system exerts a remarkable influence as a predisposing cause of gout; and my friend, Dr. W. England, of Winchester, as the result of his experience, spontaneously volunteered to me a similar remark. Inveterate forms of dyspepsia may be traced in many cases to the influence of salts of lead in the drinking-water, its pernicious influence expressing itself differently in different constitutions, although never amounting either to colic or to paralysis.

Treatment.—The treatment of *colica Pictonum* is extremely simple. The objects to be obtained are to procure stools, a copious discharge of urine, and perspiration, with a view of eliminating the poison from the body. To allay pain is also an urgent necessity. For these purposes five grains of calomel, fifteen grains of jalap, and one grain of opium, should be administered as soon as the patient is seen; and at the end of two hours about two ounces of *camphor mixture*, combined with a drachm of *sulphate of magnesia*, and twenty minims of *tincture of hyoscyamus* may be given every two or every four hours, till the bowels are freely evacuated, when relief more or less complete is obtained. The mixture should be continued at proper intervals for three, four, or five days, when the patient, though greatly weakened, has in general recovered.

In a few cases, however, the pain continues, and with considerable severity, after the bowels have been freely evacuated. The practice in these instances is to apply a blister to the epigastrium, and to keep the blister open for a few hours; and this additional application will generally complete the cure.

The patient is also much relieved if placed in a warm bath, and at the same time directed to inject repeated enemata of hot water, that stools may be readily obtained. In the absence of the warm bath, a large lintseed or mustard poultice should be applied over the abdomen.

With respect to the cure of lead palsy, an endless variety of treatment, both local and general, has been tried, but with so little positive result that, when the patient has recovered, it has been doubtful whether it has been owing to the great length of time that has elapsed, or to the medicines he has been taking. It has been believed that sulphur has the power of neutralizing the effects of lead by forming some innocuous compound with it. It is not known, however, whether any such compound is really formed, but a remedy of a very useful kind exists in the form of a *sulphur bath* (TODD). The ingredients of this bath consist of from *two* to *four* ounces of the *sulphuret of potassium*, mixed with from twenty to thirty gallons of water. The *ergot of rye* (*secale cornutum*) has been said to produce a considerable increase in the power of the flexor muscles of the arm in about a fortnight, and the improvement gradually extends to the flexors, till at the end of about three months the patient has recovered. This may have been the natural result of elimination of the lead. The experiments of Orfila long ago rendered it probable that lead is removed from the body by the kidneys; and *iodide of potassium* promotes the elimination of lead in this way. It may be used with advantage combined or not with the *citrate of iron*, the use of iron, in some form or other, having been found of benefit in cases of palsy from lead contamination. Dr. Parkes has chemically proved that lead can be made to pass off by the urine, by the action of *iodide of potassium*, in the same way as mercury is known to be eliminated.

The principle upon which the *iodide of potassium* acts has been pointed out in a most interesting manner by Melsens. He assumes that the lead is in actual union with the affected tissues, being retained among them as an *insoluble* compound. The *iodide of potassium*, after its absorption into the blood, combines with the lead, and forms with it a new and soluble salt. The poison is thus liberated from its union with the injured part, dissolved out from the damaged fibre, and once more set afloat in the circulation. Thus the poison and the remedy are cast out together by the urine (MELSENS, WILLIAM BUDD). It is necessary, however, to notice the dangerous phenomena which may at first supervene on the administration of *iodide of potassium* in cases of lead poisoning; and great caution is necessary in the employment of this remedy in man for the first few days. At the moment when the metallic compounds fixed in the body become dissolved or transformed, the phenomena of acute poisoning may occur, caused by their liberation. So much is this the case, that the treatment may be supposed to be at first hurtful rather than beneficial. The patient should have beside him a graduated solution of the *iodide of potassium;* and should begin with a small dose (fifteen grains during the twenty-four hours), and afterwards increase or diminish it according to his pains and sensations (MELSENS).

M3

Galvanism, in the form of Faradisation, ought to be used as a local stimulant to the nerves, with the precaution that its application is not to be continued too long each time. Ten or fifteen minutes, at three different periods of the day, or of every second day, and persevered in for not less than four weeks, will be found of great service (TODD, ALTHAUS). The beneficial influence will follow, although, in the commencement of the treatment, even a current of very high tension does not cause any movement whatever in the paralyzed muscles. In such cases the beneficial influence seems attributable to the restoration of mobility to the molecules of nerve and muscle by an induced current, and which is necessary to enable them to be physiologically active. Severe shocks, especially in the commencement of the treatment, should therefore be carefully avoided, as by such the weakened excitability of nerve and muscle may be reduced, in place of being fostered and developed (ALTHAUS, l. c., p. 112 and 119). It would be rational, however, to defer the application of galvanism till the lead has been completely eliminated.

Nov 26/61

GOITRE.

LATIN EQ., *Bronchocele;* FRENCH EQ., *Goître;* GERMAN EQ., *Kropf*—
Syn., *Struma;* ITALIAN EQ., *Gozzo.*

Definition.—*A specific affection of the thyroid gland, induced by the persistent use of water which has percolated through magnesian limestone rocks or strata, and containing the soluble salts of lime in solution.*

Pathology and Morbid Anatomy.—The characters of the swelling of the thyroid gland, associated with this morbid state, appear to be different at different stages of its existence. At first the tumor is soft, but it gradually acquires a firm and even a cartilaginous consistence. In the soft condition the cell-elements of the gland seem to secrete a fluid of a thick, ropy, viscid, gelatinous appearance; but when the consistence increases, the hypertrophy of the cell-elements is generally more obvious than the fluid secretion, its blood-vessels seem increased in size and number, and ultimately cysts become developed, in which the glairy fluid abounds. In the more advanced cases, osseous, or at least calcareous deposits occur, and occasionally the whole organ is transformed into an osseous-like capsule, filled with matter of various kinds, which has been likened to jelly, suet, and honey. Sometimes the gland preserves its original lobulated form, its relative proportions being maintained; at other times there is no distinction of parts or lobules. The right lobe is more often enlarged than the left (Alibert, Rickwood, Greenhow). Solid aggregations of calcareous particles have been found in the goitrous gland (Ceely). The tumor, originally of a simple nature, is liable to enlargement of its arteries, to expansion of its cells, or the formation of cysts on its surface and in its interior, or to inflammation and ulceration of its component tissues. Such ulceration is apt to assume a malignant scirrhus-like appearance.

The prevalence of the disease is limited to certain districts of peculiar geological formation; and wherever it prevails, popular opinion has always regarded the water used for drinking as being in some way connected with its cause. Alike in England and in Oude, where goitre prevails, the people are convinced that water in some way is the cause of goitre. It was at one time believed that *snow-water* from the summits of lofty mountains contained the poisonous material which established *goitre* among the inhabitants of the valleys. The people of almost all the valleys of Switzerland drink snow-water, or the water of the glaciers; but *goitre* abounds in some of the valleys only; and in Greenland and Lapland, where snow-water is commonly used, goitre is unknown. Again, the disease exists in countries in which snow is never seen, as in Sumatra; and in places where snow never lies sufficiently long to be used as a drink, as in Derbyshire. It prevails in places where *pump-water*, rather than *surface-water*, is used. Still, the evidence is very conclusive which points to something specific in the quality of the water as tending to the development of *goitre.* At Nottingham, in England, where this disease prevails, the common people refer it to the *hardness* of the water—*i. e.*, to its impregnation with calcareous salts, *sulphate* or *carbonate of lime;* and it has even been affirmed that the presence of magnesian limestone always implies the endemic co-existence of the disease (INGLIS). In Captain Franklin's expedition to the polar sea, *goitre* was found to be very prevalent at Edmonton, where the soil is calcareous, and contains numerous fragments of magnesian *limestone.* The disorder attacks those only who drink from the *water* of the river (the Saskatchawan). In its worst form it is confined almost entirely to the half-bred women and children who make use of the river-water. The men, who are often from home journeying through the valleys, drink the melted snow, and are less affected; and, should incipient symptoms of the disease come on in winter, when they live at home and use the water of the river, the annual summer voyage to the sea-coast generally effects a cure. The natives who use *snow-water* only, and drink from the rivulets which flow through the plains in summer, are exempt from the disease; but the residence of a single year at Edmonton, if the river-water of the Saskatchawan is used, is sufficient to render a whole family the subjects of goitre (RICHARDSON). The disease has been known to occur and to affect a family in a very short time, who, being free from the disease while using the *surface-water*, had a well dug, and obtained their water by tapping a limestone rock; and after drinking from this well for a short time the disease appeared among them. There are some waters in a goitrous district in Switzerland, issuing from the hollows of certain rocks, and trickling along crevices in the mountains, the drinking of which will produce *goitre,* or augment goitrous swellings, in eight or ten days, while the inhabitants who avoid these waters are free from the disease (BALLY, WATSON). Dr. Coindet, of Geneva, states that the use of the hard pump-water in the lower streets of that town brings on goitre very speedily; and at Cluses, on the Arne, numerous cretins and goitrous persons are seen in the streets; while lofty cliffs of mountain limestone tower over the town; and through the crevices of these cliffs copious streams of water flow. In Yorkshire, Derbyshire, Nottingham, Hants, and Sussex, in England, where the disease prevails, there is a ridge of magnesian limestone running from north to south through the centre of the district. All along that line goitre prevails to its greatest extent; and, diverging to either side, the disease is found to diminish (Inglis, *Treatise on English Bronchocele*). The disease has been found to prevail in one great section of the province of Kemaon, in India, south of the Himalayan mountains, and to be almost entirely absent from another section of that district. Both of them agree in their external aspect, altitude, and climatology, but differ so remarkably in their geological formation that an examination of the rocks of the district, into the very villages where the disease abounded, or did not abound, enabled one to predict whether the inhabitants were affected with goitre or not. No instance occurred, in a district extending over 1,000 square miles, in which goitre prevailed to any extent where the villages were not situated on or close to limestone rocks (M'CLELLAND). Dr. M'Clelland visited 126 villages scattered promiscuously over an area of upwards of 1,000 miles. The following are the results he obtained:—

1. Five of these villages were built upon hornblende and mica slate, or on siliceous sandstone, or on green sandstone. They contained 290 inhabitants, not one of whom was a *cretin*, or was affected with *goitre*.

2. Seventy-one of the villages in the same district were built upon clay-slate. These contained 3,957 inhabitants; and among them there were twenty-two persons with goitre, or *one* in two hundred of the population. There was not a single cretin.

3. Thirty-five of the villages, having a population of 1,160, were built upon Alpine limestone; and in them 390 persons, or more than *one-third* of the inhabitants, had goitre, while thirty-four of them were cretins, or about one person in every thirty-five.

Lastly, goitre is extremely frequent at Secrora, near Lucknow, and in all that district of Oude which stretches towards Nepaul and the Goruckpore district beyond the Gogra. In the jungles of the Teraie, at the base of the Nepaul hills, the disease is very frequent; and in Nepaul itself, among the inhabitants of the *Cis* and *Trans*-Himalayan regions, it is constantly met with (BRAMLEY; GREENHOW; *Indian Annals* for 1857 and 1859). All along the line of Teraie, on to Goruckpore, goitre is so prevalent that one in ten persons is afflicted with the horrible disfigurement. The kingdom of Oude is geologically made up of the diluvial detritus of the Himalayan chain, which abounds in limestone, and the soil of the district contains abundance of lime, which is taken up by the waters that percolate through it from the rivers and from the rains and floods. The lime thus taken up and held in solution with carbonic acid gas is frequently found deposited round nuclear fragments of flints or stones, and is then known by the name of "Kunker;" so that wherever "Kunker" abounds, there soluble salts of lime, silica, alumina, and sometimes magnesia and protoxide of iron will be found (Sleeman, O'Shaughnessy, Greenhow).

There is a remarkable circumstance connected with the prevalence of goitre in Oude, which is, that it affects animals as well as man. At Hissawpore, a village about twelve miles distant from Secrora, on the Surjoo river, dogs and other animals are affected with it (Greenhow). Mr. Bramley noticed the same curious fact in Nepaul; for "on one occasion a goat brought forth a kid with a goitre as large as its head. Puppies of a month old, bred from English dogs, are very frequently affected by it, as are also lambs."

A curious outbreak of *acute goitre* occurred in 1860 in the garrison of Briançon (Hautes Alpes). The mean strength of the garrison during the year was forty-eight officers and 954 men; and from this force fifty-three cases of acute goitre (fifty-one soldiers and two *enfants de troupe*) were admitted in the year, and in the first three months of 1861. One case occurred in as short a time as *eight* days after arrival at Briançon, and one after *sixteen* months' stay; but the majority (thirty-nine) occurred after from *eight* to *eleven* months' sojourn. The rapidity of growth of the gland was remarkable. In some very predisposed subjects eight days sufficed to show a large increase; and the form of the tumor was most frequently bilateral. The sanguino-lymphatic temperaments and robust constitutions were those most attacked. There was no obvious hereditary tendency; but several of the men came from departments where goitre is more or less prevalent. The men who came from maritime places, and who were placed at Briançon under quite unusual conditions (4,285 feet above the sea-level), suffered most. M. Collin, who records the outbreak, does not say a word about the composition of the water; but the position of Briançon renders it highly probable that the water of the place is charged with lime and magnesian salts (Parkes in *Army Med. Department Sanitary Report* for 1860, p. 385).

The disease is known to prevail at the base of lofty mountains in many parts of the globe. It is endemic at the foot of the Alps, where it is frequently associated with *cretinism*—a sort of idiocy, associated with atrophy of the brain and deformity of the body. It is also endemic at the foot of the Apennines. It is common in Derbyshire, where it is called the "Derbyshire Neck." It is met with in some flat situations in Norfolk; and in one village about five miles from Cambridge it is extremely common (WATSON). In South America goitre is met with both in the upper and in the lower course of the Magdalen river, and in the flat high country of Bogota, 6,000 feet above the level of the stream (HUMBOLDT). It is also common at the base of the South American Andes. In North America many cases occur in the vicinity of the Blue Ridge, in Virginia. It is prevalent in the mountainous regions of Pennsylvania, New York, New Hampshire, and Vermont (DUNGLISON). In India it prevails in Oude, and along the line of the Himalayan range. It seems to be more common in females than in males, and is rarely seen before the age of puberty; but in districts where the disease abounds, it is on record that children are sometimes born goitrous of goitrous parents (GODELLE, WATSON). The evidence of hereditary transmission, in the strict sense of the term, appears to be doubtful; but predisposition may exist in some, rather than in others, to the development of the disease.

Cretinism.—The condition of idiocy named *cretinism* (and associated with goitre in many districts) is of great interest; but the relations of the two are not yet clearly understood. The idiocy of *cretinism* is associated with deformity and imperfection of the bodily organs, the brain, in common with other parts, participating in the imperfection and deformity. (1.) It may be defined as:—"*A condition of imperfect development and deformity of the whole body, especially of the head. It is endemic in the valleys of certain mountainous districts, and is attended by feebleness or absence of the mental faculties and special senses; and is often associated with goitre.*" The affection of the mind varies from mere obtuseness of thought and purpose to the most complete obliteration of all intelligence. (2.) Three *varieties* are to be distinguished :—“ (*a.*) *Complete Cretinism*—Synonym, *Incurable Cretinism,—Cretinism characterized by idiotcy, deaf-dumbness, deficiency of general sensibility, and absence of the reproductive power.* (*b.*) *Semi-Cretinism,—A degree of cretinism in which the mental faculties are limited to the impressions of the senses and the bodily wants; the general sensibility is obtuse, the head is badly formed and drooping, the speech is rudimentary, and the reproductive powers are feeble or absent.* (*c.*) *Incomplete Cretinism*—Synonym, *Curable Cretinism,—A degree of cretinism in which the mental faculties, though limited, are capable of development; the head is moderately well formed and erect, the special senses, the faculty of speech, and the reproductive powers are present.*” Dr. Guggenbühl, of Zurich, was the first to recognize the fact that the mental state of *cretins* could be improved by improving the growth and condition of the body. In 1842 he succeeded in buying the mountain of Abendberg, which encloses on the W side of Lauter-brunnen valley the plain of Interlaken, and there he established an hospital for these unfortunate children. There the infant cretins, removed from the low, close valleys (in which the malady too often finds the circumstances most congenial for its development), are fed and trained in “the free, dry, cool, and bracing air of the open but sheltered and sunny slopes of the Abendberg. With but few exceptions, *cretins* are goitrous; and it has been said that when both parents are goitrous for two generations in succession, the offspring, being the third generation, are sure to be cretins (WATSON). The cretin is found chiefly in the valleys of the Pyrenees and the Alps, in the mountains of Syria, in the hilly parts of China, and in the Himalayan regions; but the disease is not confined to the lower valleys of Switzerland, or to those other mountain districts of the Old and New World which resemble it in physical conformation. All over Europe the victims of this disease may be seen; and Virchow found, in his official inquiry into this subject, that no less than 133 decided cases were living in the villages of Lower Franconia; and in Germany, Sweden, Norway, England, and even in London, isolated cases of *cretinism* are to be met with. The stature of the *cretin* is diminutive; his head is of great size, but flattened at the top, and spread out laterally; while the countenance is vacant and void of intelligence. The nose is flat, the lips are thick, and the tongue is large. The skin is dark-coloured, coarse, and rough. The abdomen is sunken and pendulous; the legs are short and curved.

Virchow's dissection of the heads of *cretins* has led him to conclude that the primary abnormality of the brain commences with the growth of the bones of the *basis cranii*, and especially with the *sphenoid* and the adjoining parts. In the normal state the basilar part of the occipital bone, the sphenoid and ethmoid, with their intervening cartilages, form a portion of an arch; while the same parts in a *cretin* are early ossified into the form of a rectangle, early union of the bones taking place, with various lesions of the intervening cartilages. With such early union, arrest of growth occurs at that part of the skull; but various compensatory developments continue in other parts. Hence the *prognathous* face, and the sinking of the root of the nasal bone. Irregular and partial union of the sutures at an early age is a frequent morbid condition of the insane, associated with an atrophic condition of the *gyri* below the site of union. The oblique downward direction of the orbit in *cretins* is brought about by the compensating growth of the skull generally, and more especially of the *malar* the *frontal*, the *temporal* bones and *zygomatic* arches, in consequence of the deficient development of the *sphenoid* bone. The stunted development of the bones at the base of the skull gives a very short distance between the front and middle part of the cranium; while the diminished growth of the nasal septum and of the jawbones gives a *prognathous* form of face alike to the cretin, the negro, and the monkey.

It may generally, therefore, be concluded, from the cumulative nature of the evidence, that a poison exists in association with lime and magnesia in geological formation, whose action induces undue ossification and thickening of the base of the cranium, tending to diminish the size of the foramina for blood-vessels (KÖLLIKER, VIRCHOW); and it is fair to connect the unusual NB quantity of lime taken into the system with such premature and abnormal ossifications. Wherever chemical examination of the water used by the inhabitants of the different places where goitre and cretinism prevail has been made (as it has been especially in India), it has always been found to contain a large quantity of carbonate of lime; whereas the water derived from the clay-slate rock, and which was drunk by the inhabitants who did not suffer from *goitre*, contained none. Such observations as those described, and especially those of M'Lelland and Greenhow, show that neither the atmosphere, the elevation above the sea-level, the physical aspect of the country, nor locality, have anything to do with the production of goitre; but they prove almost to demonstration that the affection is due to some specific action of the drinking-water which flows from rocks of a particular geological formation named magnesian limestone. The circumstances under which these affections were found by M'Lelland to exist in the low, burning plains of Bengal, formed a striking corroboration to his observations in the hills of Kemaon. Goitre and cretinism are very prevalent in different parts of the district of Goruckpore. The soil of the district is of two sorts. One, to which the natives give the name of *Bhat*, characterizes the lands bordering the river Gunduk and its branches. This soil is remarkable for the large proportion of calcareous matter which it contains. One specimen, on analysis, yielded upwards of twenty-five *per cent.* of carbonate of lime. Goitre and cretinism are very prevalent in the villages built upon this soil. In some of them ten *per cent.* of the population are affected; and of the children in the villages where goitre prevails ten *per cent.* are *cretins.* The dogs and cats of these villages are also often affected with the disease. On the other hand, the lands on the banks of the Gogra consist of a soil to which the natives give the name of *Bangar.* It is much less retentive of moisture than the *Bhat* land, and requires irrigation for the production of winter crops. This Bangar soil is very siliceous, and contains scarcely any lime. Goitre and cretinism are unknown in the villages built upon this soil (*Brit. and For. Med.-Chir. Review*, Jan., 1861).

The natives of Oude ascribe their goitres to drinking certain waters; and they adduce cases to prove that by partaking of the water of certain wells they get the disease, and by deserting those wells they sometimes become cured of it (GREENHOW). Thus almost all writers who have written on the subject agree that, in some way or other, the condition of the water has to do with the production of goitre. Remarkable instances are known wherein the exchange of well for rain-water, for drinking purposes, has been followed by the best effects, and even by the disappearance of goitrous tumors. Dr. Greenhow states that in Oude, where the water of wells believed to be injurious, in consequence of their excessive impregnation with lime, has been

[illegible]

given up, and other water used instead for drinking, great benefit has been felt, and goitres have decreased in size, even though the subjects of them have continued living in the same village as before. He was assured also, by several of his patients in Oude, that certain wells were known by them to be deleterious, and that the natives of the villages avoided them accordingly, having learned to do so from experience. He tested the water of the wells most shunned by the natives, and found it to contain a great excess of lime; and he concludes, from his own investigations, in connection with others, that the use of drinking-water containing lime is the main cause of goitre. How it acts on the system is as yet unknown.

A form of *goitre* totally different from the endemic form has received the name of *ex-ophthalmic goitre,* the *goitre* of *anœmia* or *spanœmia,* and may be defined as "*Enlargement, with vascular turgescence of the thyroid gland, accompanied by protrusion of the eyeballs, anœmia, and palpitation.*" It is rare in children; more common in females than males; and co-exists with wasting discharges, or supervenes upon them; such as in leucorrhœa, menorrhagia in females, and hæmorrhoids in males. It is sometimes associated with heart disease. The normal nutrition of the nerve centres is obviously impaired. Sleep is disturbed and unrefreshing. Digestion is impaired. Pallor and anæmia therefore ensue, with palpitation of the heart and carotid arteries. A systolic *bruit* may be heard over the region of the heart, and sometimes over the carotids; and during any excitement a rushing or throbbing feeling is experienced in the head. The thyroid body now seems to act as a diverticulum. Simple hyperæmia prevails in the gland, which subsequently becomes hypertrophied. The ex-ophthalmic state is similarly induced; continued distension of the intraorbital vessels presses the eyeballs forwards; and the ex-ophthalmic state may be reduced by pressure applied to the carotids. In fatal cases the eyes are observed to recede within the orbit after death (BEGBIE). Vision is rarely impaired. Dilatation of the cavities of the heart is the lesion which is induced in that organ, and dilatation of the veins is the last expression of the disease (Fletcher in *Brit. Med. Journal,* 23d May, 1863).

Treatment of Goitre.—The indications for treatment are,—(1.) Removal from the district where the infection occurs, or the improvement of the water used as a drink; and (2.) The elimina-

℞ Iodum gr V
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tion of the poison. As in the case of mercury and of lead, so we find that *iodide of potassium* has a wonderful effect in subduing the swelling, and probably in eliminating the poison which produces goitre, whatever that may be. *Iodine* has thus acquired the reputation of being almost a specific against goitre (COINDET, STRAUB, GAIRDNER, MANSON, LUGOL). In robust subjects it has been advised that the administration of *iodine* should be preceded by general blood-letting, on the principle that the abstraction of blood favours absorption; but this should not be done unless the *iodine* does not seem to be producing any effect; and whatever may be the preparation of *iodine* employed, it must be persevered in for a length of time, and the dose gradually increased (DUNGLISON). The best form of administration is that in which the *iodine* is mixed with and dissolved by *iodide of potassium.* It is then held in solution, and is sometimes known as *Lugol's solution.* It is made by dissolving *one part of iodine* (five grains) with *two parts of iodide of potassium* (ten grains), and adding water (to the extent of *one pint*). It contains *one grain* of iodine in four ounces of the solution. The treatment ought not to commence with a larger dose than *one drachm* three times a day. Small unirritating or alterative doses are the most efficient, and they may be gradually increased when necessary. The remedy may also be employed externally in the form of a liniment or ointment—the *unguentum iodum compositum,* of which a small portion may be rubbed upon the swelling night and morning. In some parts of India the application of an ointment of the *biniodide of mercury* was found very efficacious. The ointment is prepared by adding finely powdered *biniodide of mercury* to melted lard or mutton suet. This ointment is then applied to the goitre about an hour after sunrise; and is rubbed in, by means of an ivory spatula, for about ten minutes—*the patient sitting with his goitre held well up to the rays of the sun as long as he can bear the exposure.* The ointment will probably produce a blistering effect, although no vesicles appear on the skin; and in the course of the day the ointment should be gently rubbed in again, and the patient sent home, with orders not to touch it with his hands, but to allow the ointments to be gradually absorbed. A second application is sometimes necessary in very bad cases. In 1855 no less than 500 or 600 persons were sometimes treated in a single day; and it is estimated that altogether about 60,000 patients have been so treated; so that the cases in the district are now far less numerous than formerly; and the disorder is thus being extinguished (Mouat in *Indian Annals* for April, 1857).

When medical treatment fails, surgeons have attempted to give relief to the symptoms by one of three operations; but so long as the disease does not interfere with any of the important functions of the body, nor produce serious discomfort, surgical interference is not warrantable. These operations are,—(1.) The introduction of setons through the tissue of the diseased gland—an operation which has been successful. A thin double wire is to be passed through the gland, and left there for a week (Quadri, Tanner, James). (2.) Tying the thyroid arteries which supply the goitre with blood, and so starving the tumor, has been attended with varied success (Coates, Brodie, Earle, Wickham). These means having failed, (3.) The gland has been extirpated—an operation which few surgeons would now think of undertaking.

Dr. Watson justly observes, regarding these surgical interferences for the radical cure of goitre, that "there is not one of which the *average* results have been sufficiently prosperous to warrant its repetition, except in cases where life is put in jeopardy, or made miserable by the swelling; and where other methods, and particularly the treatment by *iodine*, have been tried and have failed" (*Principles and Practice of Physic*, vol. i., p. 795). He makes, however, an exception in favour of puncturing any cell or cyst containing fluid, which sometimes makes up a considerable portion of the tumor. Such cysts may be punctured without much risk, and with great relief to the patient.

The indications for treatment in *ex-ophthalmic goitre* are, to allay the irritability of the stomach by the use of ice; to give bland, unstimulating, nutritious food in small quantities and at short intervals; to produce sound and refreshing sleep by morphia, or any such stimulating soporific; to administer digitalis; to steady the weak heart and control its excitement. Iron may improve the state of the blood; but the *hygienic* conditions in which the patient lives are mainly to be rectified, (Fletcher, l. c.) Dr. J. Warburton Begbie recommends the use of *belladonna* in combination with iron.

PARALYSIS OF THE LOWER LIMBS PRODUCED BY THE USE OF *LATHYRUS SATIVUS.*

Definition.—*A specific form of paralysis, commencing more or less suddenly by stiffness in the legs about the knees, weakness of* *the loins, unsteadiness of gait, till at last paralysis becomes confirmed, and the feet are so dragged upon the ground that, with the feet tending to turn inwards, and the knees bent, the great toe scrapes the ground. The disease occurs from the use of the flour of the beans of the* Lathyrus sativus; *and ill-health is apt to occur when the flour of this vetch exceeds one-twelfth part; and if the proportion used as food amounts to one-third, the consequences may be serious.*

Pathology.—Attention has recently been called to this form of paralysis by Dr. Irving, civil surgeon of Allahabad, as extensively prevalent in part of that district. Village after village in Pergunnah Barra, on the right bank of the Jumna, contain many cripples and lame persons, whose paralysis is well known by the natives themselves to be due to their having lived too much upon bread made from the flour of the *Lathyrus sativus;* and they are well aware that it has a peculiar effect on the lower part of the spine (IRVING). From statistics that have been collected on the subject, it is found that a proportion of 3·19 *per cent.* of the population are rendered useless by this disease (Court and Irving in *Indian Annals* for 1857). Different villages are affected in different degrees and proportions. The country where it prevails has the appearance of a vast swamp, and it appears that the *L. sativus* is the vetch which is most extensively cultivated as an article of food. It is common enough in most parts of India, and is frequently sown with wheat or barley, and cut down green as fodder for cattle. The ripe bean is used as food when made into flour, but it is generally used with wheat or barley flour; and it is only when it exceeds *one-twelfth* part that it is injurious; and when it exceeds *one-third,* then the specific paralysis sets in. Wheat flour will not grow in the district, therefore the natives are in a great measure left to feed upon this deleterious bean, and suffer in consequence. This form of paralysis is also known in Thibet; and even in Europe it has been known to follow the use of the *L. sativus* as an article of food; and other species of the same genus are occasionally known to render bread poisonous (DON, TAYLOR, LOUDON). Cattle, horses, and birds, when fed on the beans, are said to become paralyzed (SLEEMAN, IRVING). The use of bread made from the flour of the *L. cicera* has been known to establish complete paralysis of the lower extremities in a young and healthy man in a few weeks. Six or seven individuals of the same family, who had been in the habit of eating such bread, suffered more or less from similar symptoms, and one died (Vilmorin, *Ann. d'Hyg.*, Avril, 1847, p. 469; Taylor *On Poisons*, p. 536).

Symptoms and Phenomena.—The paralysis is observed most frequently during the rainy season in India—cold and wet being perhaps an exciting cause, so that the first lameness may be a mixture of palsy and rheumatism. Men who had gone to bed quite well awoke in the morning feeling their legs stiff, especially at the knees, their loins weak, and their gait unsteady. Fever does not seem to attend the accession of the more obvious phenomena; but pain gets worse, and eventually the lower limbs become quite paralyzed. The patient walks with difficulty, the toes turn inwards, the legs waste, and the great toe nail scrapes the ground, till, in persons who go barefooted, the nail has been known to get rubbed down to the quick. Males are said to be more often affected than females; and the *Ryots* are more liable to the disease than the *Zemindars.*

Treatment.—Some cases seem to have been benefited by generous diet, tonics, the use of strychnine, and of blisters to the loins; but nothing is known definitely on the subject, nor have we any records of the morbid state of the spinal marrow in such cases. Of course, the bad quality of the food must be set right.

CHAPTER XI.

PATHOLOGY OF THE PARASITIC ORDER OF ZYMOTIC DISEASES.

The Parasitic order of diseases are so called from the fact that a great variety of lesions and symptoms of organic disorder are brought about by the presence of *animals* or of *plants* which have found a place to live and subsist within or upon some tissue, organ, or surface of the body of man, or of other animals and plants. The diseases of this order may be considered as due either,—(1.) To the existence of parasites from the *animal kingdom;* or, (2.) To parasites from the *vegetable kingdom;* and all of which live either upon some surface or within a cavity of the body, or within the substance of some of its tissues or organs.

From the animal kingdom we have the *entozoa* and the *epizoa*, and from the vegetable kingdom the parasitic diseases are due to *epiphytes* and *entophytes*. It is only recently that we have been able to point with distinctness to a vegetable parasite finding its way actually into the substance of animal tissues, and there progressing in development. Dr. H. V. Carter, the Professor of Anatomy and Physiology in the Grand Medical College of Bombay, has described a "'*fungus disease*' of the foot, in which numerous minute tubercles, resembling fish-roe, lie beneath the muscles," and affect the tissues from the bones to the skin (*Trans. of the Med. and Phys. Society of Bombay*).

Plants, as well as man and animals, have their peculiar parasites and parasitic diseases. The mistletoe is a familiar example of a *vegetable parasite;* and the oak apple, or gall-nut, is a familiar example of an *animal parasite* affecting a plant.

It is known, and in many instances it is capable of experimental proof, that some of these parasitic diseases (vegetable as well as animal) may be transmitted or communicated indifferently from animals to man, and from man to animals. The *tape-worms*, the *encysted*, *vesicular*, and *round worms*, are examples of parasites intercommunicable among animals; and *Tinea*, from the "*Dartre tonsurante*" of the horse, ox, and cat, having been communicated from these animals to man, are instances of vegetable parasites intercommunicable among animals. It may be that the blights of plants, or the causes of them, are also communicable to animals and to man. We know that some of the diseases of man and animals are intimately related with famines and unwholesome food, and that famines are due more to diseases of vegetable and animal life than to destruction or loss of food.

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The records of history furnish numerous examples of periods of blight in the vegetable kingdom, associated with epizoötics among the lower animals, and with epidemics affecting the human family (See Sir William Wilde's *History of Ireland*, compiled in connection with the census taken ten years ago). The relative connection of these events has scarcely yet attracted the attention of pathologists, human or comparative. Here, indeed, is a wide field for investigation—a territory almost yet unexplored. The medical service of Her Majesty's British and Indian armies gives golden chances for observation, if the chances are seized at the moment, and the observations connected with the facts already known. To the more salient of these facts the attention of the student is here directed.

Since the beginning of the present century, when Rudolphi published his systematic work on the entozoa (1808), almost every year has contributed new and important facts, which render the subject of *Parasitic diseases* one of increasing interest to the pathologist and the physician. The subject abounds with most puzzling riddles in natural history and pathology, especially concerning the reproduction, the development, and the propagation of parasites. So long as 170 years ago (1691), the independent nature of such structures as the "hydatid cyst" was established by Tyson (*Phil. Trans.*, cxciii., p. 506); and it was stated by Pallas in 1766 that all the cystic worms were forms of tape-worms belonging to one species—namely, the cystic or hydatid tape-worm; but it was not then known how their generation and propagation was effected. For a very long time the received doctrines regarding the generation and development of living beings were tacitly set aside in behalf of such "existences." They were believed to arise spontaneously. Inquiry was thus set at rest, curiosity seemed satisfied, or investigations followed a fruitless direction—as when observations were made on such cysts, in the hope of discovering in them some evidence of the existence of organs of generation, or evidence of some process of generation analogous to what prevails in other animals. Ova were looked for, and organs of generation were looked for, where neither ova nor organs of generation existed. The calcareous particles visible in the tissues of those animals were at one time mistaken for eggs, and described as such, in the membrane of the *Cysticercus* (1841). At last, in 1842, a great insight was obtained regarding the nature of the generation and development of these and other parasites by the publication of facts which showed that amongst a certain class of minute *Cercariæ* (worms of a microscopic size found in stagnant water), the generation of them was carried on through a series of broods produced from one parent, each brood differing from the parent and from each other. The discovery of this fact was due to Steenstrup. He described the phenomena under the name of "alternation of generation" amongst these *Cercariæ* which ultimately live within the body of different mollusca (*Planorbis* and *Lymnæus*).

These observations gave quite a new direction and impetus to investigation; and Steenstrup himself foretold that the hydatid cysts would be proved to be undeveloped tape-worms, each cyst capable of producing a tape-worm after its kind.

This view was at once taken up, and independently worked out by Eschricht, Nordmann, Von Siebold Kuchenmeister, Kræmar, Zenker, Leuckart, Weinland, in Germany; Von Benedin, in Belgium; Dujardin, Blanchard, and Robin, in France.

Many physiologists and physicians of this country have been no less accurate observers. Barker, Bristowe, Nelson, Erasmus Wilson, Gulliver, Gull, Jenner, Busk, Rainy, Cobbold, and Bastian may be particularly noticed; and many valuable records have been published in isolated papers by officers of the Army Medical Department.

The conjoint researches of these extensive workers have found most philosophical expositors in this country in Dr. E. A. Parkes, the Emeritus Professor of Clinical Medicine in University College, and now Professor of Hygiene in the Army Medical School (*Brit. and For. Med. Review*, 1853); in Dr. Allen Thomson, Professor of Anatomy in the University of Glasgow (*Glasgow Med. Journal*, No. x., July, 1855); and lastly, in Dr. William Brinton, in the *Brit. and For. Med.-Chir. Review* for 1857. From these and many other later sources the following concise account may be given relative to the parasitic order of diseases, and their rational treatment.

Kuchenmeister and Von Siebold were the first *to prove by experiment* that the hydatid or vesicular worms were the young or larval states of tape-worms; and they demonstrated—(1.) That each parasite had an independent life of its own. (2.) That most animals have each their own peculiar parasites—that even parasitic animals are themselves infested with parasites—an observation embodied in the Hudibrasian couplet,—

“~~These~~ Bigger fleas have ~~other~~ little fleas ~~to bite 'em,~~ upon their legs to bite 'em
~~And these fleas, fleas, *ad infinitum*.~~”
And little fleas have lesser fleas, and so ad infinitum

The experiments of Kuchenmeister and Von Siebold further demonstrate—(3.) That some parasites pass or migrate from the body of one animal into that of another (including man), or from one part of the same animal to another cavity or viscus in it; such migrations being required for the introduction of the entozoa or their ova into the animals they inhabit, and where they undergo those series of changes about to be described, by which they reach maturity. (4.) That thus, through food or drink, or both, entozoa pass into the human body, finding their way into the most delicate tissues, as most minute ova or embryos. (5.) That they undergo progressive changes of development towards maturity in each of the new localities where they find subsistence and protection.

We cannot now rest satisfied with a mere knowledge of the general appearance of these so-called "worms" as they are found in man and animals. It behoves the physician to ascertain their origin, their source, and their mode of entrance into the body they inhabit. The easy but unsatisfactory hypothesis of "spontaneous generation" can no longer be entertained. On the contrary, it is now clearly established that all the parasitic entozoa are produced more or less directly from fecundated ova. The general and minute anatomy of these "worms" must be studied, as well as their modes of generation, of reproduction, and phases of progressive development, the various metamorphoses of their individual forms, and their transmigrations from one animal into another. We must become acquainted with their existence even in plants, as well as in animals, and in other animals besides man, especially in such animals or plants as constitute the food of man—fish, flesh, fowl, mollusca, and crustacea,—and especially all fresh-water plants, or plants which grow on moist ground.

A knowledge of details relative to generation and reproduction is absolutely necessary in order to appreciate the nature of parasitic diseases. Indeed, without such knowledge no advance is likely to be made in the prevention of these diseases. It is this kind of knowledge which has recently led to most important practical results in the history of animal parasites, and which most of all seems capable of extending the science of parasitic diseases, especially in relation to human pathology, and the rational treatment of such diseases.

Parasites of animal organization exist in man and animals in every grade of development; and the first lesson for the student to learn is, how to distinguish entozoa which are sexually complete from those parasitical productions which are destitute of sexual organs, but which have long been regarded as distinct animals.

At least thirty well-marked forms of entozoa have been described as infesting the body of man. They may be enumerated in a classified list as follows :—

* LIST OF GENERA AND SPECIES OF HELMINTHOID ENTOZOA WHICH HAVE BEEN DISCOVERED INFESTING THE HUMAN BODY.

A. Solid Worms :—Platylmia ; vel, Sterelmintha.

I. Cestoidea—Banded, riband-like, girdled, or tape-worms, in the form of—

1. Mature sexual parasites, androgynous, and living in the alimentary canal.

(a.) *Tæniæ.* 1. *Tænia solium* (Linnæus), the common tape-worm of man in this country. Pork measle
2. ,, *mediocanellata* (Kuchenmeister), the common tape-worm of man on the Continent. Beef Measle
3. ,, *marginata* (Batsch, Cobbold).
4. ,, *elliptica* (Batsch, Cobbold).
5. ,, *acanthotrias* (Weinland, Cobbold), its larva, scolex, or cysticercus only known.
6. ,, *nana* (Siebold), a very small filiform *Tænia.*
7. ,, *flavopunctata* (Weinland, Cobbold).
8. ,, *echinococcus* (Siebold).

(b.) *Bothriocephali.* 1. *Bothriocephalus latus* (Bremser) ; vel, *T. lata* (Linnæus), the broad tape-worm, endemic to man in some localities only. Its embryo is ciliated and developed in water (Knoch).
2. *Bothriocephalus cordatus* (Leuckart), new to science; recently found in North Greenland.

† 2. Immature non-sexual, cystic, or vesicular parasites, the embryonic form of the genera sub (a.) *Tæniæ.*

(a.) *Cysticerci.* 1. *Cysticercus tæniæ cellulosæ* (Rudolphi), the larva or scolex of the *T. solium.*
2. ,, *tæniæ mediocanellatæ* (Leuckart), the larva or scolex of *T. mediocanellata.*
3. ,, *tenuicollis* (Rudolphi), the larva of *T. marginata.*
4. ,, *tæniæ ellipticæ*, at present unknown.
5. ,, *tæniæ acanthotrias* (Weinland), only the cysticercus found ; mature *Tænia* not yet found.
6. ,, *tæniæ nanæ*, at present unknown ; probably inhabits insects (Leuckart).
7. ,, *tæniæ flavopunctatæ*, also at present unknown.

(b.) *Echinococci.* 8. *Echinococcus hominis* (Rudolphi), the larva of *Tænia echinococcus.*

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* The individual names in this list are similar to those published by Dr. Cobbold in a number of the *Lancet*, before the publication of the second edition of this work. In that list a number of forms were introduced for the first time by Dr. Cobbold, which had never before been noticed by any of our systematic writers; and Dr. Cobbold took great pains in working out this point. His name, therefore, appears to identify them in the list (See also his great work *On Parasites*, recently published).

† *N.B.*—The appearance produced in the flesh of animals by the growth of these vesicular parasites has been named " the measles," or " *measly flesh.*"

II. Trematoda—Fluke-like parasites.
  1. *Fasciola hepatica* (Linnæus); vel, *Distoma hepaticum* (Rudolphi).
  2. *Distoma crassum* (Busk); vel, *Distoma Buskii* (Lankester).
  3. *Distoma lanceolatum* (Mehlis).
  4. *Distoma ophthalmobium* (Diesing).
  5. *Distoma heterophyes* (Siebold).
  6. *Bilharzia hæmatobia* (Cobbold); vel, *Gynæcophorus hæmatobius* (Diesing).
  7. *Tetrastoma renale* (Della Chiaje).
  8. *Hexathyridium pinguicola* (Treutler).
  9. *Hexathyridium venarum* (Treutler).

B. Hollow Worms:—Nematelmia; vel, Cœlelmintha.

I. Ascarides—Unisexual, body attenuated posteriorly, and still more so anteriorly, mouth with *three* tubercles, tail of the male narrower than that of the female.
  1. *Ascaris lumbricoides* (Linnæus).
  2. *Ascaris mystax* (Rudolphi, Cobbold); vel, *Ascaris alata* (Bellingham).
  3. *Trichocephalus dispar* (Rudolphi).

II. Oxyurides—Unisexual, body more attenuated posteriorly than anteriorly, rudimentary tubercles round the mouth, tail of male thickened.
  1. *Oxyuris vermicularis* (Bremser).

III. Trichinæ—Unisexual, cystic, and free.
  1. *Trichina spiralis* (Owen).

IV. Sclerostoma—Unisexual, body slightly attenuated anteriorly, mouth with four hooks, tail of male cup-shaped.
  1. *Sclerostoma duodenale* (Cobbold); vel, *Ancylostoma duodenale* (Siebold).

V. Strongylus—Unisexual, body attenuated posteriorly, mouth with six lobes, tail of male cup-shaped.
  1. *Strongylus bronchialis* (Cobbold); vel, *Filaria bronchialis* (Rudolphi).
  2. *Eustrongylus gigas* (Diesing); vel, *Strongylus renalis* (Moquin-Tandon).

VI. Speroptera—Unisexual, tail spiral, and furnished with marginal appendices.
  1. *Speroptera hominis* (Rudolphi).

VII. Filariæ—Unisexual, body equal (filiform), mouth with three tubercles, tail simple.
  1. *Filaria lentis* (Diesing); vel, *Filaria oculi-humani* (Nordmann).
  2. *Filaria medinensis* (Gmelin).

C. A third class may provisionally be regarded as accidental Parasites. These are—

Pentastoma constrictum (lung, liver; W. Coast of Africa).
Anthomia canicularis, larva, exciting causes of boils.
Pentastoma denticulatum vestris hominis (Siebold), liver and small intestines.

The *sexually mature entozoa* inhabit either the alimentary canal of animals or the cavities of the lungs; or, to express it generally, they inhabit such parts of the body as are in immediate or free communication with the external air. On the other hand, the *non-sexual or immature entozoa*, while parasitic, all live enclosed in cysts; such cysts being situated either in the parenchyma of organs, or in close internal cavities—*e. g.*, the eye, within secreting tubes, blood-vessels, and the like. In such places these non-sexual parasites are all proved to be *incomplete* animals. They are the embryos, larvæ, or early forms of entozoa, which only attain to sexual maturity by migration from the place of their earlier abode into the alimentary canal, or pulmonary or other open cavity of different animals. Or, leaving their encysted parasitic state in the condition of larvæ, they reach maturity in a free state, when they are developed in water, in earth, mud, or upon moist plants, or in other conditions favourable for them.

The cystic or vesicular entozoa, established by Rudolphi as a separate order of parasites, are to be distinguished from those which are not vesicular, but which are also enclosed in cysts. Some of the early parasitic forms of *round worms*, as well as others, are thus enclosed in cysts (*Trichina spiralis*). All entozoa so encysted are found to be immature; and in no instance has the encysted entozoön been known to attain sexual completeness, however well grown it may appear to be, so long as it remains enclosed in a cyst. Sometimes cysts only are found, which may be identified as pathologically altered conditions of cystic or encysted entozoa. When free, all these entozoa come at last to acquire sexual organs, and, when they have arrived at maturity, to exercise the function of sexual reproduction. The number of fecundated ova which most of them produce is enormous. In a tape-worm, or *ascaris*, there are many millions; but "the struggle for existence" consigns the greater part of them to death as the food of animals unfavourable to their growth as parasites.

The process of fecundation and the development of the embryo from the ovum have now been actually observed in a considerable number of the parasitic entozoa; and it is to be remembered, as a general fact, that the development of the ova rarely takes place in the same animal, or in the same part of an animal, where the parasitic entozoön has passed its life and has exercised the generative function. There is either a migration from a parasitic to a free condition for a time (e. g., *Guinea worm, Ascarides, Cercariæ*); or from one animal into another animal, the free condition intervening (e. g., *Bothriocephalus*); or, lastly, the migration may take place from one part to another of the same animal who is the unfortunate host (e. g., *T. spiralis;* and cases of tape-worm giving rise to *Cysticercus*). Some entozoa, known only as incomplete or immature animals in the parasitic mode of life, attain to sexual maturity in the free state; others again, and perhaps the greater number, after living free for a time, become sexually complete in the parasitic condition (*e. g.*, the *Ascarides* and the *Bothriocephalus*).

"The migrations or changes of habitation of the entozoa, or their ova or embryos, appear to take place in a variety of ways: *first*, by their being passed out of the body of the inhabited animal with the fæces or other excretions; *second*, by their being introduced into the bodies of inhabited animals with their food or drink; *third*, by their directly piercing the integument or other tissues; *fourth*, by their piercing the membranes and parenchyma, entering the blood-vessels, being distributed through them, and subsequently piercing their coats to attain other situations.

"Some of these entozoa are directly developed from their ova, without undergoing more remarkable changes than those which are known usually to accompany the process of embryonic evolution in many other animals. Other entozoa are subject to individual metamorphoses, or the embryo passes through successive stages of development, of so remarkable a character as to mask the regular sequence of the phenomena of progressive formation. There are others of the entozoa which are subject to still greater changes in the progress of their existence,—changes upon which great light has recently been thrown by the remarkable researches of Steenstrup and others, in regard to what has been called alternate generation or *metagenesis*. Thus some of the entozoa, by a non-sexual process, undergo that peculiar form of multiplication in which the immediate progeny of development from the ovum is dissimilar from the parent, but produces, without the aid of sexual organs, another progeny, which either itself, or by repetition of an analogous process, returns to the parental form. This is a process of the nature of an internal or external gemmation, which is often attended with a prodigious multiplication of the number of individuals. In some entozoa, again, metamorphosis and metagenesis are combined. It is obvious that the external conditions necessary to maintain these varieties of the vital states must be different," (Allen Thomson, *Glasgow Med. Journal*, l. c.)

The lesions and diseases caused by the existence of parasites rather tend to embitter existence than to cause death; and they are especially frequent amongst soldiers. With one exception—namely, in the case of the immature cystic parasites—the disorders induced are, as a rule, not severe; indeed, it is a condition of parasitism that it should not actually destroy the life of the animal from which it derives its own subsistence.

It is the immature parasites which tend to destroy the life of their host by the lesions they induce, and the destruction of parts which they cause, when they pass from one place to another, or from one state to another onwards to maturity. Thousands of mature worms infest children, yet they do not appear ill. But such is not always the innocent history even of the mature worms,—undefined illnesses, violent and sudden pains, febrile phenomena like typhoid or rheumatic fever, chronic inflammations, wastings, convulsions, chorea, epilepsy, amaurosis, apoplexy, giddiness (staggers in sheep and horses), are the grave results which sometimes befall human or other animals who may become the unfortunate hosts of such undesirable guests as mature or immature encysted parasites. Sometimes even death is the result.

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CHAPTER XII.

DETAILED DESCRIPTION OF THE PARASITES, AND OF THE LESIONS ASSOCIATED WITH THEM.

SECTION I.—THE ENTOZOA.

TAPE-WORMS—*Cestoidea.*

Definition.—*In their mature condition the tape-worms are all more or less jointed entozoa, of a riband-like form, marked with bands, or girdled. Each mature joint or segment is of hermaphrodite conformation, containing at once male and female reproductive organs, which produce fecundated ova. In their immature condition the embryo penetrates the tissues, and becomes encysted. In this stage of development they are known as the "cystic entozoa."*

Pathology.—Eight varieties of true tape-worms have been found in man, and two varieties of the *Bothriocephalus.* But two only of the true tape-worms are of frequent occurrence—namely, the *T. solium* and the *T. mediocanellata.* The former is the one endemic in this country; the latter is the more common tape-worm on the Continent and in South Africa.

The *Bothriocephalus latus* is endemic in some well-defined localities, chiefly in continental Europe; and the *B. cordatus* is new to science, having been but recently found in North Greenland (LEUCKART). These tape-worms have been known for a very long period; but they have not always been distinguished from each other. Indeed, the distinguishing characters are but recently known. They have often been confounded together under the name of "solitary worm," because it was believed they lived singly. This, however, is a mistake.

The *T. solium* and *T. mediocanellata* appear at first sight to be very similar to each other in general appearance. The latter is much the larger of the two. It is only in the alimentary canal —the small intestine of man—that they become sexually mature, in natives of France, Italy, Holland, Germany, and Great Britain. The *Tænia* has been also found in Egypt, and is very common in natives of Abyssinia;—so common is it there, that its absence is the exception to the rule. The affection is there looked upon as a natural occurrence; and so general is this belief, that when a slave is sold into Abyssinia he provides himself with a plentiful supply of kousoo—the local remedy for expelling the parasite.

The Mature Tape-Worm Parasites.

1. *Tænia solium.*—It is the common tape-worm of this country, composed of segments of variable size, numbering from 800 to 1,000; and these being endowed with considerable contractile power, the length of tape-worms varies greatly, and so also does the width and thickness. Nine to thirty-five feet may be quoted as average measurements of length. The body narrows from the posterior to the anterior extremity, till towards the head it becomes a mere thread. The parenchyma is soft and white, with microscopic calcareous particles, sometimes mistaken for ova (because they are round or oval), scattered through nearly every part.

The HEAD (fig. 4) is very small, but it may be seen with the naked eye to be of a globate or triangular form, with black pigment ingrained into its substance, which may be the remains of blood. On the most anterior part of the head, with the aid of a lens magnifying twenty-three or twenty-five diameters, four circular projections, equidistant from each other, may be seen.

Each has a circular disc or cup, surrounded by a rim of dense tissue.. The parasite is able to elongate and retract these projections; so that, while opposite ones are put forward, the two others are kept back. Between the suckers, and anterior to them, is a convex protuberance or rudimentary proboscis, which is impervious, and surrounded by a double row of hooks (fig. 4, *a*, also fig. 5). These are siliceous, and number twelve to fifteen in each row. The shape of these is peculiar. They consist of a straight stem or handle, a middle nob, and a distinct hook or claw, surrounded by a sheath or sac. Bremser believes that a *tænia* loses these as it gets old; or it may shed them periodically by rows; and being lost, they may not be renewed, and so the parasite may be got rid of in the course of nature.

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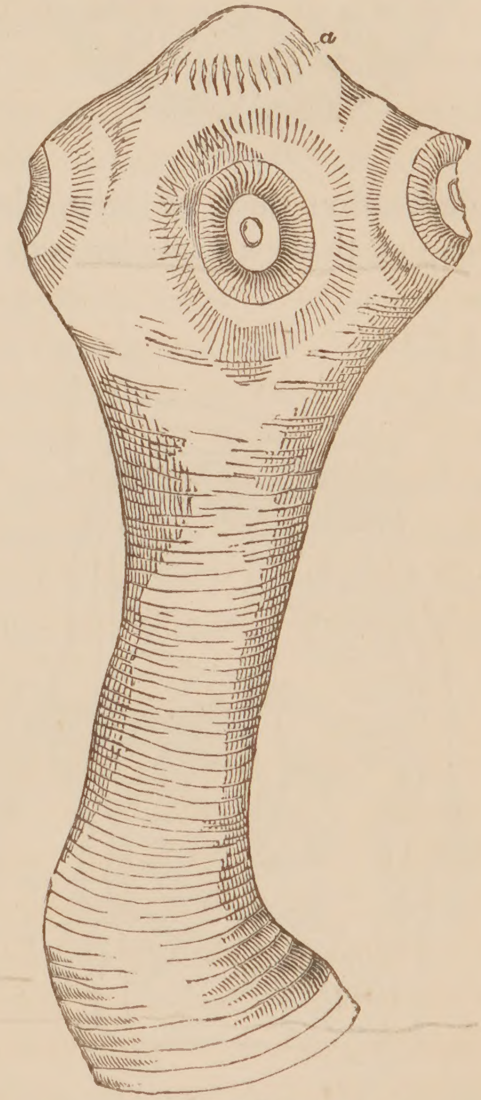

Fig. 4.*

The head terminates a long and slender neck, on which there are transverse markings, but no visible joints or articulations. Such joints distinguish the body; and these joints, segments, or zoönites are united end to end in a single linear series.

The characters of the segments vary at different parts of the body. They are square or oblong; and in the mature part of the animal the length of them is equal to twice the width. The anterior border of each segment unites with the anterior or previous segment, and is thinner than the posterior border, and also narrower. The posterior border is thick, and projects or overlaps the border of the segment next in order, and is undulating or indented. The lateral margins incline to each other anteriorly. The two surfaces are flat or slightly elevated towards the centre.

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* Head and neck of *Tænia solium.*—(*a.*) Circle of hooks.

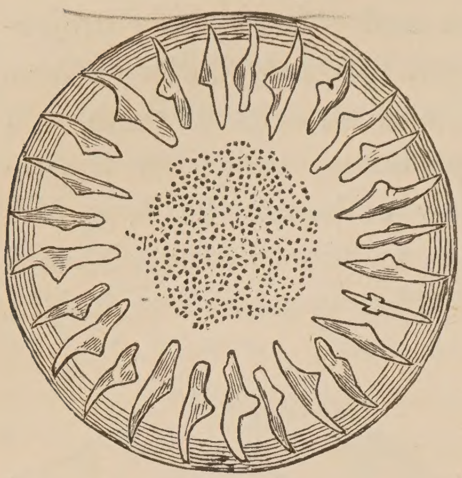

Fig. 5.*

Each mature segment contains male and female organs of generation. The opening at the side of each segment is the sexual aperture, indicated by a prominent papilla, once supposed to be a sucker. These openings are sometimes at one side and sometimes at the other. Two, three, or four consecutive segments may have them on the same side, or on opposite sides; but there is no regular alternation. With a lens a cup-shaped depression may be seen, showing two mesial apertures. From one of these a *lemniscus* or rudimental penis projects, connected with a horizontal (deferent) canal (sometimes indicated by dark pigmentary material) from a vesicular body in the middle of the posterior end of the segment (Owen).

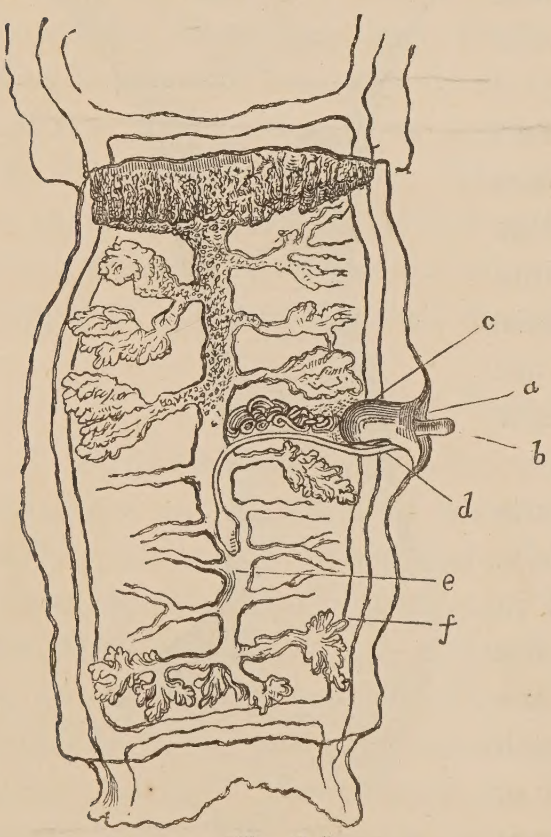

Fig. 6.†

Behind this male orifice is the opening to the female organs, by a canal leading to a lobulated organ, which is the ovary or germ-stock. These parts are more distinctly developed the farther the segments examined are from the head end of the worm. While the head continues to adhere, by its circles of hooklets and oscula, to the mucous membrane of the intestine, the last or caudal joints, when they have arrived at sexual maturity, are separated one by one, or in numbers together, and new joints are at the same time gradually formed behind the head. Thus growth and develop-

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* Circle of hooks more highly magnified (after Leuckart).

† Proglottis of *Tænia solium* magnified.—(*a.*) Genital pore, with its preputial cover or sheath-skin; (*b.*) Lemniscus or penis; (*c.*) The oviduct; (*d.*) The seed-vessel; (*e.*) The uterus; (*f.*) The water vascular system of vessels (after Rokitansky).

ment take place mainly towards the neck of the parasite, by a process of transverse fission; and thus a segmented individual or compound animal appears to grow. This segmentation of individual links by transverse fission ceases when the organs of generation begin to develop themselves in them; and when those are complete, the segment or link has arrived at sexual maturity or completeness. It is now called a *proglottis.* Thus all the new segments come to be developed between the head and those which are advancing to sexual completeness; and if the characters of complete sexual development be taken as the distinctive mark of individuality, then each segment of the tape-worm may be looked upon as a distinct animal; and this separation by fission or segmentation may be considered as analogous to what takes place in the medusæ or polypes—a kind of alternate generation, in which the *segments, zoönites,* or *proglottides* may be regarded as making up a colony of animals. It is only in the alimentary canal of man and other animals that the tape-worms, or cestoid entozoa, attain to sexual maturity; and in all of them the ova are fecundated before being discharged, and may often in the *T. solium* be perceived to have undergone the first stage of their development before they are excluded from the oviduct of the mature segment. The expulsion of the ova occurs in some one of the following ways:—(1.) The impregnated segments separate from each other, and passing out of the body singly or in numbers with the fæces, or without any fæcal evacuation, become decomposed, and so the eggs are set at liberty. The activity of these separate segments is retained for a considerable time after passing out of the body—a circumstance which led to their being at one time taken for a distinct species of worm, to which the name of *Vermes cucurbitini* (from resemblance to a pumpkin seed) was applied. The contracted appearances of a segment during its movements out of the body are represented by the forms shown in the accompanying wood-cut (fig. 7).

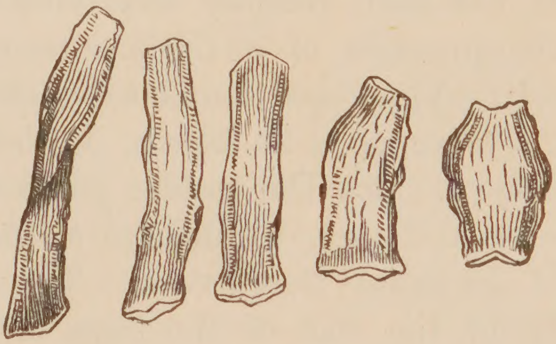

Fig. 7.*

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* Proglottides of a *Tænia* (*mediocanellata*) in various stages of contraction (after LEUCKART).

One may readily observe the activity displayed by these *beauties of nature* as they disport themselves on the recently extruded excrement of almost every constipated dog. The expelled joints may be seen to become violently contracted shortly after their expulsion, as if the stimulus of physical climate in their new situation provoked excessive contortions. The long single joints thus expelled become still more elongated by contractions of their transverse fibres, while the alternate contractions of these fibres with the longitudinal ones cause shortening of the joint to such an extent that its breadth exceeds its length. Such a sequence of contractions produces movements which simulate those of progression in a worm, and thus these segments may be seen to move some little distance from the spot on which they may have first fallen, discharging ova during their march from the interior of the segment. (2.) Eggs are thus discharged through the genital pores of the mature segments; and if the segment be slightly squeezed, the ova may be pressed out. Such a contingency is not unlikely to happen within the rectum, when, by constipation or otherwise, the matured joints are retained, and constitutes one of the most serious dangers which the matured tape-worm inflicts on the animal it inhabits, and one of the strongest indications for its removal. It has been recently ascertained that in one or two instances the presence of a *Cysticercus cellulosæ* (the embryo of the *T. solium*) has been found to co-exist with the previous prolonged existence of a *T. solium* in the intestinal canal of the human subject. (3.) The mature joints of the adult tape-worm seem, in some instances, to undergo a disintegration within the intestine of the animal they live in. Thus, Kuchenmeister on one occasion found the wall of the large intestine of a dog occupied by a white sandy powder, the particles of which, on examination under the microscope, turned out to be innumerable ova of a *T. serrata* which lived higher up the bowel, accompanied by its separated joints.

The mature segments are often expelled from the human rectum at the rate of six or eight a day, and they exhibit evidence of very active vitality for some time. Moisture is favourable for maintaining their existence, and for favouring the spread of the eggs over herbs, grass, ground fruit, or vegetables, which may become the food of man or of cattle.

The structure of these ova (fig. 8) is peculiar; and the provisions possessed by their coverings for preserving the embryo are important points for consideration in connection with their transmissions through apparently impossible conditions into the bodies of animals, where they become further developed; and in connection with their powers of resistance to therapeutic agents (which have been called anthelmintics or vermifuges) administered for their removal.

It is only in their earlier stages of development that they are really the analogues of ordinary ova. In the blind extremities of the oviducts of the mature joint of the tape-worm the shells of the ova appear to be composed of a calcareous transparent substance; and by the time the ova reach the central segments of the tube their hitherto transparent calcareous shell becomes not only much thickened, but is converted into a dark-yellow or brown mass, in the interior of which the embryo is formed, at first of the simplest structure, and most minute, being only about $\frac{1}{700}$th part of an inch in size. The admixture of these organic elements with the calcareous shell imparts to it that extraordinary power of resistance to chemical, and even mechanical, violence which it certainly possesses. Dilute acids and alkalies have little immediate effect on this leathery husk; and even after hours of immersion in them, scarcely more than a slight swelling and transparency is produced upon the shell. It is, therefore, no matter of surprise that after months of exposure to warmth and moisture, or to cold and dry air, the pulpy, putrid, or dried-up mature segments of *tape-worms* should yield ova which show no sign of degeneration or decay.

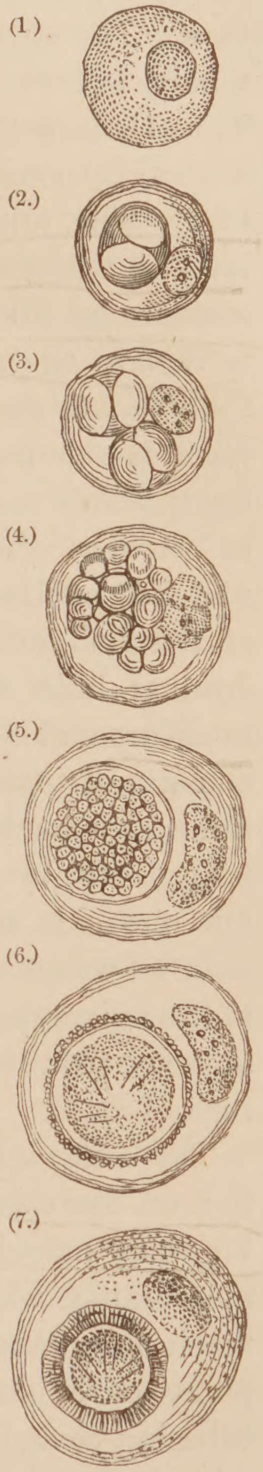

Fig. 8.*

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* Development of the ovum of *Tænia solium.*—(1.) Previous to segmentation; (2, 3, 4, 5.) Segmentation in the impregnated ovum; (6.) Appearance of the early embryo, with its three pairs of siliceous spikelets; (7.) Mature condition of the ovum containing the embryo enclosed within its leathery case (after LEUCKART).

A more or less speedy death of the expelled segments is followed by their putrefaction, hastened, it may be, by warmth and moisture. The eggs in their interior are then set free, to be carried by winds, waters, or other agents, wherever accident may determine. Thus they may lie to rot upon the soil, or they may be consumed as food by various animals which feed on such minute particles of food. The minority of these eggs, after many and long wanderings of this passive nature, may at length be engulfed unconsciously by some unfortunate animal with its food.

Within the alimentary canal of the animal which is thus so unfortunate as to eat the egg, a small embryo of most simple form is set free from the ovum by the rupture of the calcareous husk which encloses it. Such rupture is absolutely necessary to liberate the embryo, and may be effected by mechanical violence, such as friction, or crushing by the teeth in mastication of the food, rather than by solution or digestion in the stomach. Animal heat does not seem to be alone sufficient, nor is mere moisture sufficient to liberate the embryo; which when set free consists of little more than a highly contractile vesicle about the same size as the yolk of the ovum. It is peculiarly armed for progression by boring its way through the most delicate tissues. On one side of it are placed three pairs of spikelets; one pair points forwards, and the two other pairs are so placed that a pair is towards opposite sides of the embryo, or at right angles to the anterior pair. These spikelets are shown in the last two drawings of fig. 8.

The *embryo* when free is named a "*proscolex*," and commences life on its own account by efforts at active migration. By the vigorous exercise of the spikelets it makes a passage through membranes, walls of vessels, and textures of solid viscera, so as to reach localities where it becomes encysted, and passes another phase of existence. The first portion of its path is pierced by bringing close together the several pairs of spikelets so as to form a kind of wedge-shaped stiletto. The lateral pairs of these spikelets are then brought backwards to a rectangular position, and so they thrust the embryo forwards in the direction in which the anterior pair of spikelets pointed. Similarly repeated actions eventually accomplish progression to a resting-place; and the action may be aptly compared to the movements of the arms and attitude of the head of a swimmer. But this active migra-

Tænia
Proglottis
of [illegible]
Proscolex (free embryo)
Scolex (encysted embryo)
Strobila (incomplete seg. Tænia)

tion is not the sole means by which the embryo *Tænia* is enabled to traverse the animal body. The embryo may penetrate a mesenteric vein, when it will at once be swept onwards by the current of the blood to the portal vein, and passing into the minute ramifications of the portal system, may find a resting-place in the liver. Leuckart has found the embryos of tape-worms in the blood in such large numbers that he inclines to regard the currents of the blood in the vessels as the ordinary and more usual channels for the migration of the embryos. It also explains the wide diffusion of *tape-worm* embryos as *cysticerci* or *echinococci* in various stages of development throughout different viscera of the body, where they become encysted, and especially their very frequent site in the liver, peritoneum, and mesentery. Thus far completed and encysted, the embryo is called a "*scolex.*" The embryos of *Echinococci* and *Cœnuri* give rise to numerous *scolices,* which complete their development into tape-worms in the alimentary canal of another animal, when that animal happens to eat the liver or brain containing the cysts of such *Echinococci* or *Cœnuri;* but the embryos of such *echinococci* or *cœnuri* tape-worms find their way into man or animals with drinking-water, or with raw, uncooked articles of vegetable diet from moist soils, such as salads, roots, fallen fruit, all of which may be doubtless so exposed as to receive the germs or ova containing the embryos, passed along with fæcal excrement of dogs especially, and which, after being dried, are carried by wind or water in all directions.

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The third stage of development consists in the formation of segments, which are first seen in the form of marks, like girdles, surrounding that portion of the entozoön next to its oscula and hooklets, and which terminate in a caudal vesicle. It is now an incomplete segmented *Tænia,* and in scientific nomenclature is called a *Strobila;* and the development to this stage may occur while the entozoön is still within the closed cyst which has formed round it.

3

It is only in the alimentary canal of animals that the last and perfect stage of development is attained, by the tape-worm reaching sexual maturity. The segments or links marked off by the bands, joints, or girdles in the encysted *Strobila embryo* become mature segments by the development of sexual organs within them. This only takes place after the *Strobila embryo* has passed into the alimentary canal of an animal which can afford it a place to live and spend the rest of his days as a fixture attached by its hooks to the mucous membrane. The human alimentary canal is an oft-chosen place of the *T. solium* and *T. mediocanellata.* Here the tape-worm forms complete sexual segments or links, each being hermaphrodite, and tending to separate when completely mature.

After living for some time in this prolific condition, and having produced often a very large number of joints and an enormous quantity of ova, the existence of this troublesome parasite is terminated by the separation of the animal from its attachment to the intestinal membrane. When this separation occurs spontaneously, it may be that the circlet of hooklets being shed periodically, or being lost, they are not renewed, and so the prolonged life and romantic vicissitudes of a tape-worm may be thus brought to a natural termination. The whole length of the beast is then ignominiously expelled, while some reputed vermifuge, however innocent, may get the credit of its death. The apparent success of many such *parasiticides* is recorded and measured by yards of tape-worms, which, being ingeniously bottled by worm-doctors and charlatans, are duly advertised to have been passed by John Smith or Sarah Brown, after they had been dosed with the "infallible" remedy.

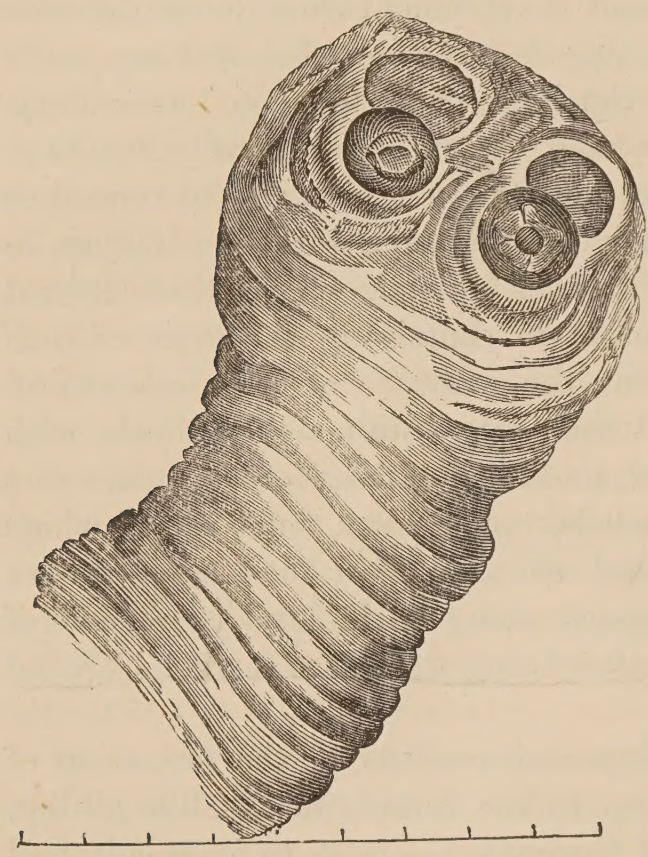

Fig. 9.*—$\frac{1}{100}$th of an inch × 23 diameters.

The length of the tape-worm in the human body has been known to exceed thirty feet, and there are grounds for believing that the *T. solium* may attain to this size in the human intestine in about three or four months.

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* Head of the *Tœnia mediocanellata*, drawn with the camera lucida by Assistant-Surgeon B. J. Jazdowski from one of three specimens, all of which were removed from the small intestines of a soldier who died at Fort Pitt in 1860, and who had been for many years a cook at the Cape of Good Hope. The specimens are in the Museum of the Army Medical School at Netley.

2. *Tœnia mediocanellata.*—This is a hookless, flat-headed tape-worm, the *cysticerci* and embryos of which are developed in the muscles and internal organs of cattle (LEUCKART); and man becomes infested with this tape-worm by eating imperfectly cooked veal and beef in which the *cysticerci* abound. It was first discovered by Kuchenmeister in 1855, and then shown by him to be different from the *T. solium.* Its head (fig. 9) is large, obtuse, and truncated, and carries no hooks. Its sucking discs are much larger than those of the *T. solium*, as if to compensate for the want of the hooks. Its segments, when mature, separate easily. The ovaries are simple, giving off sixty lateral parallel branches. The eggs are similar to those already described.

The *T. mediocanellata* has been found in several instances of invalid soldiers who died at Fort Pitt, and at the Royal Victoria Hospital at Netley. In one instance three very large and long worms existed in the small intestines, each of them precisely similar in all respects. The soldier in whose intestine they were found died of *diabetes mellitus*, and he had been a cook for many years to a military mess at the Cape of Good Hope; another case was that of a soldier who had been also a long time at the Cape.

3. The *Tœnia marginata*, produced from the *Cysticercus tenuicollis*, is only as yet known to infest man in its immature state as a *cysticercus.* The full-grown tape-worm being found in the dog and wolf, it is often confounded with the *T. serrata*, from which it differs in its comparatively bulky size and the peculiar form of its hooks. The proglottides nearly equal in size those of the *T. solium.* In its scolex or immature condition this parasite has a very wide distribution; for, in addition to its occasional presence in man, it has likewise been found in various monkeys, in cattle and sheep, reindeer, and in many other ruminants; in horses, swine, and even in squirrels. Its *habitat* is for the most part the peritoneum (ROSE and others). The *cysticerci* occasionally attain an enormous size.

4. The *Tœnia elliptica*, whose *cysticercus*, or embryotic condition, is not yet known, is common to cats and dogs, and is known to infest man (ESCHRICHT, LEUCKART). Weinland believes that the *cysticercus* will be found in flies, and that dogs obtain the larvæ by snapping at dipterous insects.

5. *Tænia acanthotrias,* like the *T. marginata,* is only known in man as an embryo or *cysticercus.* From twelve to fifteen of them were found in the muscles of a woman about fifty years of age, by Dr. Jeffries Wyman in 1845. The woman was a subject in the dissecting-room at Richmond, United States. The rostellum of this parasite is furnished with three rows of hooks, fourteen in each row.

6. *Tænia nana,* when fully grown, attains a length of eight or ten lines, and carries from 150 to 170 joints. Its hooks are essentially the same in form as those of other *Tænia,* only they are very minute, and have a peculiar form, owing to the close approximation of the claw and of the anterior root-process (Leuckart), which gives them a "bifid" appearance. Its head is comparatively large and obtuse, with a long neck. It was first described by Bilharz in 1851, having been found in Egypt in the intestine of a young man.

7. *Tænia flavopunctata* measures about eight to twelve inches long. The proglottides are short, and there is a yellowish spot, clearly visible to the naked eye, situated about the middle of each joint, which reminds one of the colour and situation of the genital organs as seen in the *Bothriocephalus.* The reproductive orifices occur all along one side of the worm, and the eggs are unusually large. Only one instance of the occurrence of this parasite is on record: it was obtained in considerable numbers by Dr. Ezra Palmer in Massachusetts, in 1842, from an infant nineteen months old. They were expelled without medicine, their presence not having been suspected (Weinland, Cobbold).

8. The *Tænia echinococcus* is very often seen in Iceland, where, in its encysted immature state, it is the cause of a wide-spread endemic disease amongst the inhabitants. This *Tænia* is a very small one, consisting of not more than three or four segments, and not much longer than a line, and carrying twenty-eight to thirty-six hooklets. It is found in large numbers in the intestines of dogs.

The *Bothriocephali,* although classed with tape-worms, differ essentially from *Tænia.* Two species have been found in man, namely,—(1.) *Bothriocephalus latus;* and (2) *Bothriocephalus cordatus.*

9. The *Bothriocephalus latus* is endemic chiefly in the north of Europe, and is found more especially in Russia, Sweden,

Norway, Lapland, Finland, Poland, and Switzerland. The inhabitants of the French provinces adjoining Switzerland are infested with both species.

Instances of *Bothriocephalus latus* are said to have occurred both in England and France; but, when carefully inquired into as to their history, it will be found that this parasite maintains a very fixed geographical distribution. For example,—Of the six specimens in the College of Surgeons of England, one is from a native of Switzerland; one from a Russian belonging to the Russian embassy in London; one from a person who had been travelling in Switzerland; a fourth happened in the practice of Dr. Gull, in the person of a little girl from Woolwich, where there is always a number of foreign ships and sailors, bringing with them native food and water; another was passed by a native of Russia, who, after a long residence in England, paid a temporary visit to his birthplace, and returned to England with this parasite as a pleasant memento of his native country.

The liability to this form of parasitic disease appears to be greatest towards the sea-coasts and along river districts. Huss, of Sweden, describes it as extremely common on part of the Lapland frontiers, in Finland, and on the shores of the Gulf of Bothnia. On the extreme coast there is scarcely a family altogether free from it—old and young, rich and poor, native and emigrants, alike suffer from this worm; and in one or two large towns on the mouths of rivers at least two *per cent.* of the population experience its attacks. On passing inland the frequency of the disease diminishes, until, eight or ten leagues from the coast, rivers, or lakes, it almost ceases to be found. The natives believe it to be hereditary. Dr. Huss attributes it to the use of salmon, (*Brit. and For. Med. Review*, l. c.)

The head of the *Bothriocephalus latus* is peculiar, and very different from the *T. solium.* It is of an elongated form (fig. 10), compressed, with an anterior obtuse prominence into which the mouth opens; an opaque tract extending from the mouth separates two lateral transparent parts which are supposed to be depressions. There are no traces of joints till about three inches from the head; and throughout the entire body the segments have more length than breadth. The whole length of the

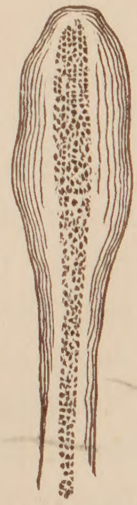
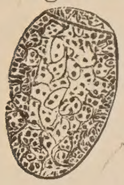


Fig. 10.

Fig. 11a.



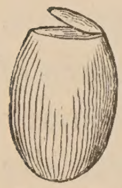


Fig. 11.

mature parasite varies from six to twenty feet. It is of a greyish-white or yellow colour; and the ova are very brown, giving the mature segments a very marked appearance. The neck is not always obvious, for the worm has the power of making it long and thin or thick and short; and there are no joints or segments to be seen in it, but merely prominent ridges. The segments, when they become first apparent, are nearly square; but afterwards they become much ~~wider~~ longer than they are ~~long~~. wide There are two orifices on one of the flat surfaces of each segment; the anterior orifice is connected with a male organ of generation, the posterior is connected with the female. The proglottides are never passed singly, but always in chains of many links, and particularly in February, March, October, and November. The ova (fig. 11) are always discoverable in the fæces, of an ovoid form, with a perfectly translucent operculated capsule, through which the segmented yolk is distinctly visible; and at the period of discharge of the proglottides the ova show merely the stage of segmentation of the yolk. The *six-hooked* embryo, cased in a mantle studded with vibratory cilia, develops itself after segmentation, protected by the capsule in fresh water, for several months after the expulsion of the proglottides. When so far matured, the lid of the capsule opens up, and the ciliated embryo escapes (fig. 11*a*), and becomes globular in shape, and moves actively about for a considerable period (a week). If during this period they do not succeed in obtaining access to the intestine of an animal adapted for their development, they lose the ciliated mantle, and perish. When these embryos are introduced by experiment into the intestines of mammals, the *scolices* and mature *Bothriocephalus* were found. Experiments in which living embryos were introduced by implantation between the brain and dura mater, and into the eyes of dogs, also under the skin of frogs, and by injection into the blood-vessels of mammals, give a negative result; *quoad* the development into *cysticerci* or *scolices*. So, also, feeding experiments with the *scolices* of the *Bothriocephalus* found in various fish lead to negative results; just as the feeding of fish with the eggs themselves. It is therefore justifiable to assume that drinking-water from lakes and rivers is the medium through which the living embryos of the *Bothriocephalus latus* find their way into the intestines of men and of mammals, (Dr. J. Knoch, *Petersburger Medicinische Zeitschrift*, 1861; COBBOLD, l. c.)

10. *Bothriocephalus cordatus.*—This species (fig. 12, *a*) has only very recently been described by Leuckart, who received about twenty specimens from Godhaven, in North Greenland, one of which was from the human intestine. The parasite measures about a foot in length, and exists in dogs in considerable abundance. It differs from *Bothriocephalus latus* in the form of the head, which is heart-shaped (fig. 12, *b* and *b′*), or obcordate, short, and broad, and set on to the body without the intervention of a long neck. The segments are distinct from the very commencement, near the head; and so rapidly do they increase in width, that the anterior end of the body becomes lancet-shaped. About fifty joints are immature; and in the largest example Leuckart counted a total of 660 joints. It displays a greater number of the calcareous corpuscles, and a greater number of lateral uterine processes (LEUCKART; Cobbold, "Remarks on the Human Entozoa," in *Proceedings of Zoological Society*, Nov., 1862).

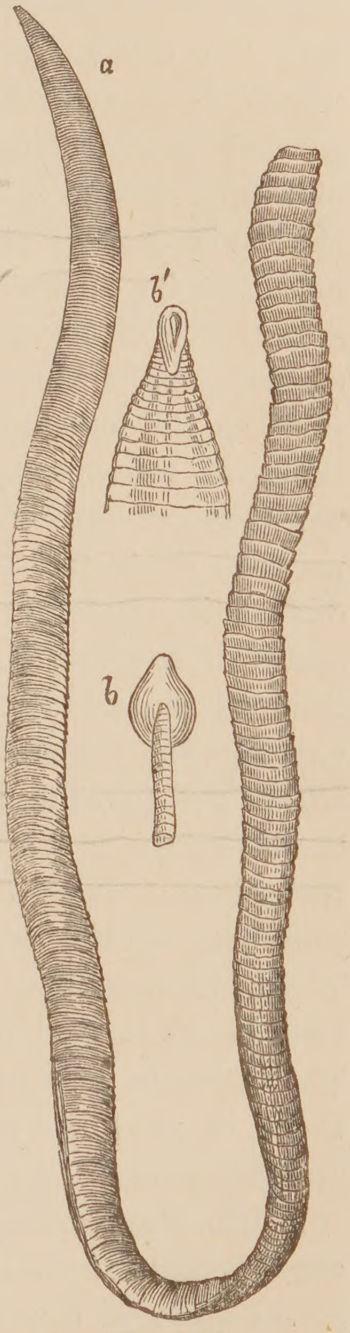


Fig. 12.*

The Immature Tape-worms, Non-sexual, Cystic, or Vesicular Parasites.

These entozoa are variously spoken of by the older, and even by many recent writers on medical subjects, under the vague terms of *hydatids, cysts,* and *acephalocysts.* They all inhabit the closed cavities of animals, or they are enclosed in cysts in the more solid parenchyma of their organs. They are represented by the *scolices* or second stage of the *tape-worm* embryo, and consist of a *Tænia* head, provided with a

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* (*a.*) *Bothriocephalus cordatus*, natural size; (*b.*) Head, back view, magnified five diameters; (*b′.*) Upper part of body and head, magnified two diameters.

similar circle of hooklets and four oscula, and this head is united by a neck to a vesicular body of variable size. These are now believed to be, as already described, varied forms of *Tæniæ embryos*, of which the following are known to infest various parts of the human body:— Pork measly

1. The *Cysticercus cellulosæ*, as seen in man and in the pig, consists of a vesicle—conical, glistening, and white—containing fluid; to this a head is attached by a narrow pedicle or neck, which is transversely lined—the lines approaching to rugæ towards the vesicle. Its size varies in solid viscera from that of a small pea to a large marble; but in free cavities, such as in the ventricles of the brain, it attains a larger size. The head and neck can be drawn as if into the vesicle, so that the form and appearance of the parasite may thus be very much altered. An external cyst encloses the parasite when it inhabits a solid viscus, such as the substance of the liver, or amongst the connective tissue of muscle; but in close cavities, such as the eye or the ventricles of the brain, there is no enveloping cyst, and the parasite floats free within the cavity. In these more free conditions it tends to grow more like the form of a tape-worm; and if it happens to be in the eye, it may soon destroy it, by fixing its hooks in some of its delicate textures. The cyst which envelops the parasite is developed at the expense of the tissue in which the parasite imbeds itself. They have been thus seen in the heart, liver, choroid plexus, the brain, in the tissue between the sclerotic and the conjunctiva, in the anterior and posterior chambers of the eye (Mackenzie), and in the retina (Graefe). The head resembles that of the *T. solium*, and carries thirty-
32 two hooks in two rows, and the neck varies greatly in length. The parasite is especially frequent in domestic swine, and in them it produces the appearance known as the "measles," or "measly pork." Beef Measle

2. The *Cysticercus ex tænia mediocanellata* is to be found in the muscles and internal organs of cattle. For our knowledge of the larval state of the *T. mediocanellata* we are mainly indebted to Professor Leuckart, of Giessen. He has artificially reared them in the flesh of calves, from the eggs of a *T. mediocanellata;* and recent experimental researches incontestibly prove that the "measles" of cattle give rise to the *T. mediocanellata.* He fed two calves with the fresh eggs of the *T. mediocanellata*, by giving

them the *proglottides* of this parasite. The first animal he experimented on died from a violent attack of the measle disease; and on dissection the muscles were found filled with measles, or vesicles containing imperfectly developed *scolices*. On the second occasion a smaller number of *proglottides* (in all about fifty) were administered, and the febrile symptoms again appeared with such virulence that Leuckart thought this animal would die also. Fortunately, after the lapse of a fortnight from the commencement of symptoms, some abatement of the disease took place, and this gradually continued until the animal was perfectly restored to health. Eight and forty days subsequent to the earliest feeding experiments (which were continued at intervals for eighteen days) Professor Leuckart extirpated the left *cleido-mastoid* muscle of the calf, and whilst performing the operation he had the satisfaction of seeing the cysticercus vesicles lodged within the muscles. They were larger and more opalescent than those of the *Cysticercus tœniœ cellulosœ*, but nevertheless permitted the recognition of the young worms through their semi-transparent coverings. The heads of the contained *cysticerci* exhibited all the distinctive peculiarities presented by the head of the adult *Strobila* (the *T. mediocanellata*). Taking the results of this experiment in connection with previously ascertained facts, the most unequivocal evidence is brought together that man becomes infested with the *T. mediocanellata* by eating imperfectly cooked veal or beef in which the *cysticerci* abound.

3. The *Cysticercus tenuicollis* is rarely found in man, but it has occasionally been found in the mesentery and in the liver. Eschricht and Schleissner have shown that these *Cysticerci* are sometimes associated with the *Echinococcus* in Iceland, (Cobbold, l. c.)

4, 5, 6, and 7 require no special notice.

8. The *Echinococcus hominis* is the larva of the *T. echinococcus;* and the first accurate description of the immature form of the parasite was published by Bremser in 1821. These parasites have been and are still often indifferently named "hydatids" or "echinococcus cysts;" but English writers have restricted the term "*hydatid*" to designate the enveloping cyst, and the term "*echinococcus*" to signify the contained entozoön. The *Echinococcus* is an extremely common parasite of the human body. It has been found in the kidneys, lungs, liver, brain, heart, spleen,

NB

ovaries, breasts, tissue of the throat, and the bones; and they are not unfrequently discharged with the expectoration, or by stool. In the Icelandic endemic disease due to this parasite there is scarcely a part of the body in which it has not been found; and its occurrence in Iceland is a remarkable example of the prevalence of *cystic entozoa* in the human subject. It appears that the people of that country have been for some time suffering to a great extent under this very remarkable hydatid disease, which mainly affects the liver, peritoneum, and subcutaneous texture. Eschricht, writing to Von Siebold, says "the disease has extended itself to such an alarming degree that about a sixth of the whole population of Iceland are affected with it, and that it is attracting considerable attention at Copenhagen." It produces a long, protracted illness, terminating with a painful death, and means of cure have not yet been discovered. Von Siebold considers it "probable that this disease arises from the immense quantity of dogs kept in Iceland for the purpose of herding sheep and cattle" (Schleissner, *Medical Topography of Iceland;* ALLEN THOMSON, l. c.; also Leared, in *Medical Times*, 1863).

In some cases only a single "hydatid tumor" is developed in an organ or part; but occasionally two, three, or more tumors may be found. These "hydatid tumors" consist externally of a firm, fibrous capsule, of a tint which varies with the organ in which it may be developed. In the liver they are white, or of a yellowish tinge. The capsule adheres intimately to the surrounding tissue, and is abundantly supplied with blood-vessels. Bands of connective tissue may be seen stretching outwards from the capsule, and incorporating it with the tissue in which it is imbedded. Within this capsule, and completely filling it, are—(1.) A gelatinous, translucent grey bladder or bladders, composed of numerous concentric hyaline layers, giving a laminated appearance to a section. It is finely granulated in some parts (degeneration?) and highly elastic. (2.) A very thin and delicate membrane is spread over the interior of this elastic hyaline bladder, as the innermost layer of the "hydatid tumor." This membrane is the mother sac of the *Echinococcus* embryo (HUXLEY), and corresponds with the germinal membrane of Professor Goodsir. It is studded with innumerable transparent cells, varying in extremes of measurement from $\frac{1}{100000}$th to $\frac{1}{3000}$th of an inch. It is the seat of the development of innumerable *Echinococci;* and to this membrane, in a fresh hydatid tumor, they are found connected by a delicate membrane, either singly or (more commonly) in clusters, the number of individuals on the cluster varying from ten to a hundred or more, as shown in the annexed wood-cut (fig. 13).

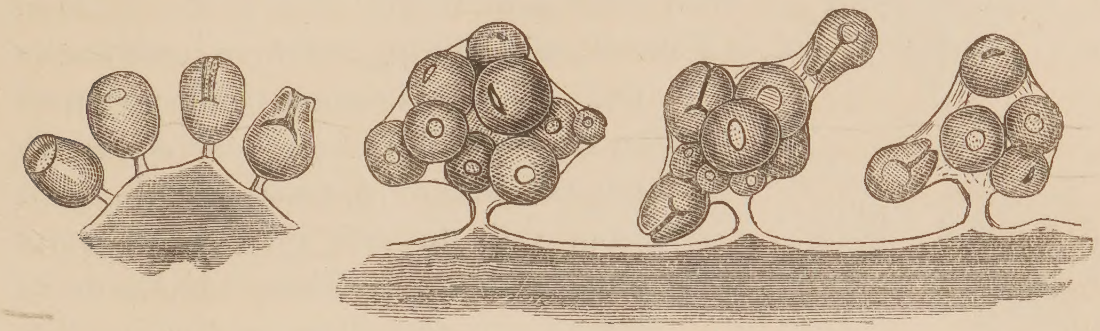

Fig. 13.*

On close examination with the naked eye these groups present the appearance of a number of delicate white particles upon the inner surface of the germinal membrane; and when the aggregation into groups consists of many individual embryos, they may be seen through a transparent cyst. They are the *scolices* or *embryos* of the *T. echinococcus* in various stages of development. The "hydatid tumor" is filled and distended with a clear watery fluid, with numerous large and small vesicles, more or less clear and transparent, floating free, or so closely packed together that they cannot be removed without some degree of pressure. Some of them, particularly the smallest, adhere to the germinal membrane. They vary in size from that of a millet-seed to a size as large as a goose's egg, and their number not unfrequently amounts to several hundreds (560, PEMBERTON), or even thousands (7,000 and 8,000, ALLEN, quoted by PLOUCQUET and FRERICHS). The larger of these free vesicles sometimes contain smaller ones of a third generation, and occasionally they in their turn contain others of a fourth generation. The size of the "hydatid tumor" and the germinal membrane must increase and grow according to the number and size of the daughter vesicles, and in proportion to the quantity of contained fluid, which is sometimes rendered slightly opaque by the quantity of embryo *Echinococci* floating free in it. From the rotundity and distension of these enclosed vesicles it is difficult to fix them for examination; and when they are punctured, their fluid contents issue from the vesicle in a jet of considerable force, impelled by the contractile power of the elastic tissue; and if the incision be of a sufficient size, the vesicle will roll up, and turn itself inside out. The *Echinococcus* embryo varies in size from $\frac{1}{18}$th to $\frac{1}{20}$th *of a line* in length in the contracted state, and from $\frac{1}{10}$th to $\frac{1}{18}$th *of a line* in its elongated form. These variations in length are according as the head of the parasite is extruded or retracted within the vesicle. The contracted state, in which the head is retracted within the vesicle, is the form most commonly seen in the "hydatid tumor," after removal from the organ in which it was developed. In this state it is usually globular or oval, and slightly flattened at the opposite poles. In the elongated state, when the head is extruded and the hooks appear outside, the parasite is usually larger at the cephalic end, where there may be seen four suctorial prominences and the circlet of hooklets.

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* Fig. 13.—Groups of *Echinococci*, showing—(1.) The pedunculated connection between these parasites and the germinal membrane; (2.) Their occurrence in groups, enveloped by a very delicately thin membrane, continuous with the germinal membrane (after ERASMUS WILSON).

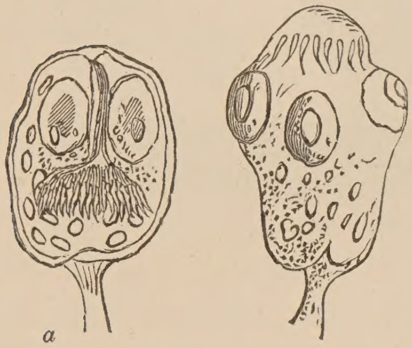

Fig. 14.*

The *Echinococci* vary much in regard to the number of cephalic hooklets they display at certain intervals of growth, but not sufficiently to give ground for specific distinctions to be made amongst them; and while the number of hooks fluctuates in all the forms of *Echinococci* that have been described, the alleged differences in the size and character of these hooklets have reference to the degree of development of the parasite (Leuckart, Cobbold). These hooks are arranged in a double festoon, round a membranous disc (fig. 15, *A*), and vary from twenty-eight, thirty-four, forty-six, or even fifty-two. They are arranged in two rows (fig. 15, *B*), one row containing longer hooks than the other; the longer ones measuring about $\frac{1}{1050}$th of an inch. They each possess a gentle curve, so that there is a concave and a convex border, and a base (fig. 16, *b c*) which encroaches on the concave border for nearly half its length. The base is broader than any part of the hook, and has a bifid end. These hooklets move on the central bifid process as on a pivot (fig. 16, *f*, *g*, *k*). Hook sacs may be distinguished with a sufficiently powerful lens. These hooklets are of so minute a size, and at the same time so extremely characteristic and important in diagnosis, that the annexed wood-cuts (figs. 15 and 16, after ERASMUS WILSON) may give an idea of their shape and arrangement.

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* Fig. 14.—Two *Echinococci* from a "hydatid tumor." The one has the head retracted within the vesicle; the other has the head extruded.

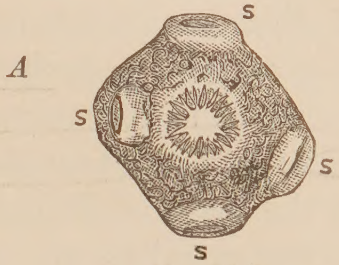

Fig. 15.*

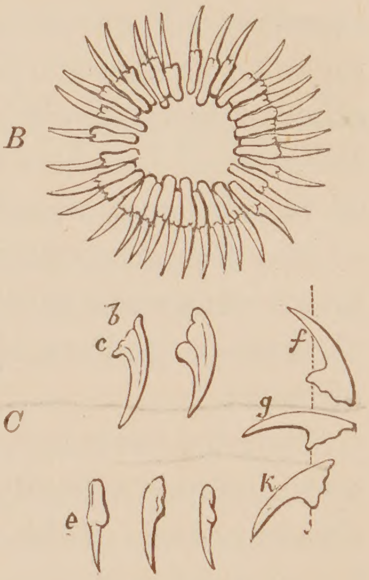

Fig. 16.†

The head of the worm is separated from its body by a groove, and at its opposite pole is an umbilical depression, which gives insertion to the peduncle which fixed it to the germinal membrane (fig. 14, *a*).

As the growth of the "hydatid tumor" advances, the external enveloping capsule gradually loses its uniform thin and smooth character. It becomes rigid, fibrous, or even cartilaginous, while its inner surface becomes rough and uneven, covered here and there with laminated deposits. Frerichs, of Berlin, has seen such capsules completely surrounded by a calcareous shell; and the thicker and more rigid the capsule becomes, the greater is the resistance opposed to the further growth of the *Echinococci*, which may even be thus arrested, so that the parasites die, and a spontaneous cure results (CRUVEILHIER, FRERICHS).

Compound "hydatid tumors" have been found in which the cavity is multilocular. Outgrowths or buds form, which give an alveolar character to the lesion (BUHL, VIRCHOW, FRERICHS).

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* Fig. 15.—(*A.*) An *Echinococcus* viewed transversely, the head being directed towards the observer; *s*, *s*, suctorial discs. The hooklets are seen to encircle a membranous disc.

† Fig. 16.—(*B.*) The circle of hooklets seen upon its under surface; thirty-four in number, seventeen long and seventeen short. (*C.*) *b*, *c*, Lateral views of the separate hooklets—*b*, The base; *c*, The central extremity, or bifid process of the base; *e*, Hooklets viewed upon the concave or inferior border; *f*, *g*, *k*, A diagram illustrating the movements and position of the hooklets. The dotted line represents the outer surface of the neck, and runs through the fixed point of the three hooks.

It has been usual to consider that there are two distinct forms of *Echinococci*, severally referable to different tape-worms; but they are now regarded as one and the same. The *Echinococci* so prevalent in Iceland are known to occur indifferently in men and oxen; and are sometimes so prevalent that about one-eighth of all the cases of disease are referable to this cause; and generally several members of one family suffer (LEARED).

Acephalocysts were first described by Laennec as growths of membranous cysts. In the present state of science they are regarded as abortive *Cysticerci* or *Echinococci*—parasites of one or other of those kinds in which the development has been arrested. Remains of hooklets have been found in them; and the structure of the cyst may sometimes be seen to be precisely similar to that of the *Echinococcus* cyst. They have been found in all those places where the *Cysticerci* and *Echinococcus* cysts are known to abound—*e. g.*, liver, spleen, kidney, bladder, and in the exostoses of bones.

Thus we have seen that each kind of *Tœnia* has not only its own definite vesicular embryo, but each *Tœnia* has a definite *Cysticercus* or *Echinococcus;* and all of them are capable of being developed or reared into *Tœnia* when transferred into the alimentary canal of a suitable animal; and conversely, the development of *Cysticercus* and *Echinococci* occurs in man and other animals in consequence of segments of tape-worms, or the ripe ova they contain, being eaten with their food.

The experimental proof of these statements it is the principal scientific merit of Kuchenmeister to have established, by experiments which date so far back as 1851; and they have since been repeated and confirmed by many other observers (SIEBOLD, NELSON, ZENKER, LEUCKART, WEINLAND, KNOCH).

The experiments of Kuchenmeister were made on a variety of animals, and in one instance on the human body. The following is a short summary of his observations, together with those of Von Siebold and others, condensed from Dr. Allen Thomson's valuable paper in the *Glasgow Medical Journal*, No. x., July, 1855, and which demonstrates the

Relation between the Cystic and the Cestoid Entozoa.—These experiments mainly consist in observing the effects of feeding an animal with the ova or larvæ with which it is designed to affect it. The first experiment of this kind was performed by Kuchenmeister in 1851. He caused young dogs to eat with their food a number of the *Cysticercus pisiformis* of the rabbit and hare, and found that after some weeks these *Cysticerci* were converted, in the intestine of the dogs, into the *T. serrata.*

The more important of the experiments devised and performed by Von Siebold confirm these results, and are described by him in his *Essay on Tape-worms.* They may be arranged as follow :—

First Series.—Ten young dogs were fed with the *C. pisiformis* from the rabbit, and being killed and opened at different successive periods afterwards, the gradual progress of conversion of the *Cysticerci* into *Tœniœ* was carefully observed in their intestines. It appeared that, by the action of the gastric fluid in digestion, first the cyst and then the caudal vesicle of the *Cysticercus* were dissolved in the dog's stomach; but the head and neck, resisting entirely the solvent action, passed into the duodenum. Here they soon became attached to the mucous membrane; and after an interval of only two or three days they were seen to enlarge, the head and neck undergoing little change, but the body elongating and transverse grooves appearing, which afterwards became more marked, and divided the body into segments. In less than two months these *Tœniœ* had attained a length of ten and twelve inches; in three months they were from twenty to thirty inches long, and the reproductive organs were fully developed in the last or caudal segments, which then began to separate as *proglottides.*

Second Series.—These experiments were made by feeding young dogs with the *C. tenuicollis*, which is common in domestic cattle, and of which the vesicle often attains a large size. Having found that the vesicle was invariably destroyed by digestion, Von Siebold contented himself thereafter with giving the heads only to the dogs, removing artificially the vesicle. Six young dogs were the subjects of this experiment, which was conducted in a manner similar to the first, and with the same result—namely, the formation of tape-worms, which reached their full development in forty-eight days, and corresponded exactly with *T. serrata.*

Third Series.—In this set of experiments the *C. cellulosœ,* from the flesh of the hog, was employed. Four young dogs received at different times a number of these *Cysticerci* with their food, and on being opened at different intervals afterwards, tape-worms, which resembled exactly the *T. serrata,* were found in their intestine, in various stages of advancement corresponding to the length of time that had elapsed. Von Siebold was struck with the close resemblance of this *T. serrata* of the dog to the common *T. solium* of man, and after an accurate comparison of various examples of these entozoa, concludes that they are identical, and not to be specifically distinguished, or that at most they are varieties of the same species, dependent only on the difference of their parasitic habitations.

Fourth Series.—This series of experiments was performed in the same manner as the last, but with the heads or scolices of the *Cœnurus cerebralis,* the entozoön so well known in connection with the disease called "sturdy" and "staggers," which it produces when infesting the brain of sheep and cattle. In order that the *Cœnurus* might be procured alive, the dogs experimented on were carried to a part of the country where a number of sheep were affected with the "sturdy." In the intestine of five out of seven dogs fed with the *Cœnurus,* great numbers of *Tœniœ* were found, at successive periods and in different degrees of advancement; in thirty-eight days the *Tœniœ* had arrived at maturity, and appeared, like those in the previous experiments, to correspond exactly with *T. serrata* and *T. solium;* in two other dogs the experiment was rendered nugatory by the dogs being ill of distemper at the time.

Fifth Series.—The last of the experiments related by Von Siebold were made with the *Echinococcus animalcules* of domestic cattle, which are probably not specifically different from those of man. As many as twelve young dogs, and also a fox, received a quantity of the small *Echinococci* in milk; and on being examined at various periods from the commencement up to twenty-six days, there were found, in all different stages of development, small *Tœniœ* totally different from any observed in the previous experiments, or indeed from any accurately distinguished or described by helminthologists. Von Siebold proposes to call this variety *T. echinococcus.* It is remarkable for its very small size—not much longer than an inch; and for the small number of its joints—which never amounted to more than three; and for the circumstance that the reproductive organs are confined to the two last segments, and the caudal joint separates as a *proglottis* at a very early period.

The last experiment to be noticed may be looked upon as the most interesting of all. Having the opportunity of repeating on a condemned criminal the experiments which he had previously performed on animals, Kuchenmeister contrived to give to this man, at seven successive times, between 130 and 12 hours previous to his execution, mingled with various articles of food, a number of *Cysticerci* from the hog and some from the rabbit. "They appear to have been partly disguised by their resemblance to the grains of rice in warm rice soup; partly by their likeness to the small bits of paste in a kind of vermicelli soup; and partly foisted on the unhappy wretch by being substituted for the small lumps of fat in blood-puddings" (*Brit. and For. Med.-Chir. Review*, Jan., 1857, p. 119). After death, a number of young *Tœniœ*, in different stages of advancement, were found in the intestine; the greater number of them loose, but a few attached to the mucous membrane. The form of the hooklets, and other circumstances, induced him to regard these tape-worms as the *T. solium*. There were no traces of the *Cysticerci* last swallowed; and Kuchenmeister was of opinion that those only which were first taken, and which were quite fresh, had been converted into *Tœniœ*, and that those taken later, being dead, had been digested with the food. Leuckart made a similar experiment. He fed a man thirty years of age with *Cysticerci* from a pig, and in two months the man had *Tœniœ*.

But the enthusiastic Germans were not yet content with the proof. M. Humbert, of Geneva, experimented on himself. On the 11th December, 1854, he swallowed fourteen fresh *Cysticerci* in presence of MM. Vogt and Moulinié. Early in March of 1855 he felt the presence of *Tœniœ*, and discharged fragments of them.

With regard to the converse experiments, the following facts may be related:—

Kuchenmeister, having previously caused the production of the *T. serrata* in a dog, by feeding him with the *C. cerebralis* from a sheep, gave to young lambs some of the ripe joints or proglottides of this *Tœnia*, and by the fifteenth day the usual symptoms of *sturdy* began to appear in the lambs. Kuchenmeister sent some of the same *Tæniæ* to Van Beneden at Louvain, to Eschricht at Copenhagen, and to Leuckart at Giessen, all of whom, in separate experiments, caused lambs in the same manner to take the *Tæniæ* segments with their food, and in all the cases the same result followed—namely, the occurrence of the symptoms of *sturdy* at a period of from fifteen to eighteen days after the mature segments of *Tæniæ* were given. The same experiment had likewise been performed by Dr. Haubner, of Dresden. He caused six young lambs to swallow the living and mature segments of a *T. serrata.* They all died of the vertiginous disease; and the *Cœnurus* cysts were found in the brains, heart, lungs, and voluntary muscles. The symptoms commenced by the fifteenth day; and in point of time their appearance was curiously constant, the vertigo being obvious between the fifteenth and eighteenth days in all the experiments.

Several of these experimenters, having examined carefully the lambs so affected, were able to detect the progressive stages of formation of the *Cœnurus* in the cortical substance of the brain, where alone these entozoa seemed to attain the true *Cœnurus* form. There were abundant traces of them in the heart, diaphragm, and other muscles, and also under the skin, in some of the experiments; but in these situations they appeared to be abortive; while in the brain they gradually grew, and in some instances the vesicle had there attained the size of a hazel nut. The brain was in all instances marked with inflamed grooves over its surface, indicating probably the track of the *Tænia* embryos; for at the end of each of these tracks, in the early stages, were found the minute *Cœnuræ.*

Another confirmation of the fact of the conversion of the ova of *Tænia* into *cystic entozoa* has been afforded by an experiment of Leuckart's, which merits separate mention. It gives the complement of the relation between the *C. fasciolaris* of the mouse and the *T. crassicollis* of the cat. Having in his possession a family of white mice, which he had employed for various experiments, and in none of which had the *Cysticercus* of the liver been perceived, he gave to six out of twelve, with their food and drink, the ova of the *T. crassicollis,* obtained by breaking up the ripe joints or proglottides of this tape-worm from a cat. Four months afterwards he found, on opening these mice, that four of them were affected with the *C. fasciolaris* of the liver; and he ascertained that in none of the mice which had not received the *Tœnia* ova was there any production of these entozoa.

From the whole series of observations and experiments that have now been made, and of which a summary has been here given, the general conclusion may be drawn, that while much probably remains to be done in the details of the subject, a most important advance has through their means been made in the explanation of the manner in which these entozoa gain access to the seat of their parasitic habitations. It appears by them to have been ascertained—(1.) That entozoa are always introduced into animals from without; (2.) That some obtain access to the body of animals from water, or other matters in which they have previously lived in the free condition, while others are taken along with animal food in which the entozoa have lived parasitically; (3.) That entozoa, when reaching sexual perfection in their parasitic condition, require to be in a situation which communicates with the external air, their most common position being the alimentary canal, and more rarely the pulmonary cavities; (4.) That almost all the entozoa inhabiting close cavities, or encysted in the bodies of animals, are only imperfect and earlier forms of other entozoa, which may attain maturity in the open cavities of the same or of different animals, or in the free condition; (5.) That entozoa rarely propagate themselves in the same animal in which they have arrived at sexual maturity, but require a different habitation, which they reach by migrations in the various modes before referred to; (6.) That the cystic entozoa are the imperfect states of different *Tœniœ;* (7.) That *Tœniœ* are almost invariably introduced, in their earlier condition, into the bodies of animals with flesh or other animal food; (8.) That if the ova of *Tœniœ* be introduced into the alimentary canal of a suitable animal, through water, vegetable food, or fruit, their tendency is, after penetrating the tissues, to become encysted, and to assume the form of a cystic entozoön, such as that of a *Cysticercus, Cœnurus,* or *Echinococcus;* (9.) That if these cystic entozoa again are taken by certain animals with their animal food, the head part (which corresponds with that of a *Tœnia*) resists digestion, and has a tendency to establish itself, and become developed into some form of *Tœnia* in the alimentary canal, by the formation of segments after attachment to the mucous membrane.

Many of the immature entozoa pass their whole life as encysted parasites, and a few even acquire the jointed form, or become partially divided into segments, while still within their closed cysts. A well-known example of this is afforded by the *C. fasciolaris*, which inhabits cysts in the liver of the rat and mouse, and has been the means of leading Von Siebold and Dr. Henry Nelson (independently of each other's observations) to the discovery of the remarkable relation now proved to exist between the *cystic* or *vesicular entozoa* and the *cestoidea* or *tape-worms.* These observers found the cystic entozoa in the liver of the mouse and rat in every stage of development, from the simplest vesicular form of the true *Cysticercus* to that which (from the number of the joints and their external form) has all the appearance of a true tape-worm, and from which, in fact, it only differs in the absence of sexual organs within the segments. A careful comparison of the form of the head, its circle of hooklets, the four oscula or suckers, and other parts in the *Cysticercus* of the rat or mouse, with those of the *T. crassicollis,* which inhabits the intestine of the cat, has shown an exact resemblance between them. Dr. Allen Thomson has repeated and confirmed these observations (Art. "Ovum," *Cyclopædia of Anatomy*). The conclusion such observations lead to is now generally regarded as established—namely, that the cat receives its *T. crassicollis* with the flesh of the mouse or rat which it may have eaten.

Symptoms of the Presence of Tape-worm and Cystic Parasites.—From what has been stated, it is obvious that these must be very variable, determined by the form of the parasite and the locality in which it exists. Almost every case has some special symptoms of its own, local, reflex, or general.

In the alimentary canal the tape-worms occasion uneasiness, or pain in the abdomen, sometimes spasmodic, gnawing, or biting, but more frequently a distressing feeling which cannot be described. Irritation at the mucous orifices (mouth, nose, and anus) are also characteristic accompaniments. The bowels may be constipated or relaxed; the stools exceedingly dark or white; the appetite sometimes lost and sometimes voracious; sleep disturbed, and temper fretful; and often, as a result of so many combined irritating causes, a remittent fever occurs, which has received the name of "worm fever." The mind is also often so much depressed as to amount to hypochondriasis.

Dog obtains Cœn by eating offal of sheep
Sheep ova of Tænia by eating grass on which
fæces passed by dog –

The symptoms of the existence of worms in the *small intestine,* such as *Tæniæ,* are often exceedingly obscure, and simulate many other diseases; so that, until a patient has passed a portion of the parasite worm, we are unable to predicate its existence with any certainty; and at no time till we actually see the parasite can we determine its species.

Prevention and Treatment of the Tape-worm and Vesicular Parasites.—The preceding history points out very clearly the means to be adopted for the prevention of *tape-worm.* At the same time, it is probable that there may be other accidental means by which the larvæ of the tape-worm may be introduced; and it will be easily understood how this may more particularly happen in the cases of butchers, cooks, or others in the habit of handling affected meat.

The instances in which the human body is affected with the *Cysticercus* or other *cystic entozoa,* though not very rare, are by no means so frequent as those of tape-worm; but they are much more serious in their effects, more obscure in their origin, and in the meantime, therefore, more difficult to prevent. Scarcely any attention has yet been given to the source from which the various individuals of the *cystic entozoa* infesting the human body may have derived their origin, but the observations already referred to make it extremely probable that the explanation of their introduction is to be sought for in the same causes which have been shown to operate in the lower animals. Thus it appears to have been demonstrated that the *Cœnurus* of the sheep proceeds from the ova or first embryos of *Tæniæ,* and it is most probable that those are obtained from the excreta of the dog. The only mode, therefore, of removing this affection from a flock in which it may have become prevalent, and in which it is well known sometimes to cause very great losses, must be the careful separation of the dogs from the sheep for a certain time; for such time, indeed, that the dog shall find no more *Cœnuri* in the offal of sheep which die of staggers, in eating which it receives the larvæ of its *Tænia;* and that the dog, being free from this *Tænia,* shall not furnish, by his excreta, the ova or embryos which, being taken accidentally with the pasture or water by the sheep, establish themselves in them as *encysted Cœnuri.* Von Siebold states the important fact, that those flocks which are entirely without dogs, and are stall-fed, are never affected with the "sturdy."

Prophylaxis, therefore, is all-important; and the entrance of the *scolices* must be prevented. The following remarks are not less revolting than suggestive. Dr. Gordon, of the Army Medical Department, thus writes :—

"Tænia appears to be of very frequent occurrence among the white troops in Upper India, and especially the Punjaub; and I have been told by some medical officers who have been stationed at Peshawur, our nearest cantonment to Affghanistan, that they firmly believe every third soldier has had tape-worm during the two years regiments remain there.

"From what I have been able to ascertain on the subject, natives are not particularly liable to tape-worm, and certainly not more so in the north-western parts of India than in Lower Bengal. This is generally attributed to their almost total abstinence from animal food; and when we consider that both Hindoos and Mussulmans—all except the very lowest classes—abhor pigs' flesh, while our own countrymen are very partial to it, and the common soldier probably not very particular regarding the early history of the animal that is converted into pork for his use, an additional circumstance in favour of the transformation of the *Cysticercus* constituting the 'measles' of pork into *Tænia* is thus disclosed to us.

"Those who have escaped the misfortune of having had to pass some years in India can form no idea of the vast herds of lean, half-starved pigs that roam over the fields and waste grounds in the vicinity of villages; neither can they have any conception of the nature of the food on which these pigs subsist.

"The natives of India perform their ordinary natural functions in the open air on a piece of waste ground left for the purpose on the outskirts of every village, and where, morning and evening, men, women, children, and pigs dot the ground at short intervals from each other. In an incredibly short space of time after the villagers have left the field it is as clean as if they had never been there, while the herd by which the clearance has been effected may be found in some shady place near or close to a tank, with the exception of a few of the more insatiable, that have gone to hunt for dead dogs, cats, cattle, and Hindoos that have paid the debt of nature since the previous meeting, and have been thrown or left on the plain to be devoured by domestic animals or vultures.

"Pigs, however, are not the only animals that live in this filthy manner in India; cattle and sheep, that are so particular in their food in Britain, acquire degenerate tastes in India; and it is needless to enter into similar particulars regarding ducks, fowls, turkeys, and pigeons, all of which are more or less used as food by our countrymen there.

"I have thus alluded to these matters with a view to indicate some circumstances that most unquestionably tend to vitiate the quality of the animal food upon which our troops in India must subsist, and I think I have at least shown a sufficient cause for almost any amount of disease in the bodies of these animals; as also why their flesh should be more liable to become diseased in Upper India than in Lower Bengal" (*Med. Times*, No. 357, May, 1857).

Abstinence from the practice of eating raw meat is to be strenuously recommended; and cases closely inquired into will often be found to take their origin from the habit of taking animal food imperfectly cooked or *underdone*. Children have been affected with *Tænia* on being weaned, from the custom of giving them pieces of pigs' flesh to suck in an uncooked state, and containing *Cysticerci*. Cooks and butchers are known to be more liable than other people to be infested with tape-worms; and in countries where raw or uncooked meat in the shape of fish, flesh, or fowl is much used, there tape-worms greatly abound, *e. g.*, Abyssinia. By contrast, this is remarkably brought out in that country. It is observed that those who abstain from flesh altogether in those countries are altogether free, *e. g.*, the Carthusian monks of Abyssinia.

Vegetables eaten green, such as salads, ought to be scrupulously clean, for it is through green vegetable food and fruits that the ova which lead to the growth of *Cysticerci* and *Echinococci* make their way into our bodies. A point of very great practical importance in preventing the spread of these encysted parasites is admirably insisted upon by Dr. Cobbold in the *Proceedings of the Linnæan Society;* and, based as it is upon a widely extended knowledge of the subject, it deserves serious attention. He suggests that in place of burying the excreta of animals known to be affected with *Tæniæ, all such excreta ought to be burned.* If they are simply buried, or merely allowed to drop and lie on the ground, multitudes of minute embryos escape destruction ; and may ultimately find their way into the human body. *All entozoa* (*not preserved for scientific investigation and experiment*) *should be thoroughly destroyed by fire when practicable, and under no circumstances should they be thrown aside as harmless refuse.*

NB

Medical Treatment.—For the ejection of *Tœniœ* from the small intestines a great many remedies have been recommended; but in the present day medical men very generally limit themselves to one or two methods, or to the action of a purgative. The celebrated Swiss remedy, purchased by the King of France, was a purgative composed of twelve grains of calomel and twelve grains of scammony, followed shortly after by half an ounce to an ounce of the sulphate of magnesia. In many cases it has been efficient.

By many the purgative treatment is seldom adopted, it being more usual to administer the *oleum terebinthinœ* alone. Half an ounce to two ounces of this medicine makes the patient slightly tipsy, is less likely to cause strangu~~a~~ry, and produces three or four motions; and in these the worm is usually found, the animal having, it is supposed, a great sympathy to this substance, lets go its hold and actively attempts to escape. This medicine may be repeated twice a week. Three-fourths of the inhabitants of Cairo are said to be infested with *Tœniœ*, and the native remedy is twenty to thirty drops of *petroleum*—an agent not greatly dissimilar. The Grenadine bark has acquired much reputation in this disease in the West Indies, but it has not supported the hopes that have been entertained of it, at least in this country.

Drs. Christison, Jenner, Gull, and others, employ, with great success in tape-worm, the *etherial oleo-resinous extract* of the male shield fern (*Lastrœa Filix-mas*) in doses of twenty to twenty-four grains—a remedy which by many is still believed to be the most efficacious. Dr. Gull's dose is one and a half to two drachms. The liquid extract of fern root is the officinal remedy of the British Pharmacopœia. It is made from the *rhizoma* or rootstalk of the *Aspidium* or *Nephrodium Filix-mas*, according to the formula:—Fern root, in coarse powder, 1 part; ether, 2 parts, or a sufficiency: percolate and distil off the ether, and the liquid extract remains. The dose is ♏30 to ♏60, in milk, or with mucilage, and should be given on an empty stomach. Mr. Squire finds the extract of the unexpanded frond equally effective with that of the rhizome. The powder may be used alone in doses of one to three drachms.

A remedy sometimes used in Germany is Chabert's *bandwurmöl*, or the "*oleum Chaberti contra Tœniam.*" It is obtained by the distillation of twelve ounces of oil of turpentine mixed with

Kamula gr 30 – ¼℥ in honey a
thick gruel –

four ounces of the *oleum animale fœtidum*, which is the crude oil obtained from hartshorn and animal bones.

A remedy of Abyssinian origin, called Kousso or *Cusso*, the flower of the *Brayera anthelmintica*, has recently been much recommended; and has doubtless been of great efficacy in some instances. It is administered in the form of powder, of which half an ounce is mixed with half a pint of warm water, and the infusion, *with the sediment*, is to be taken at two or three draughts, in the morning on an empty stomach. If the bowels fail to be moved, a brisk cathartic ought to be given in three or four hours.

℥ß Kou
Oj Aq

Another remedy of more recent recommendation is *Kameela* or *Reroo*, the *Rottlera tinctoria* of the natural order *Euphorbiaceæ*, and sub-order *Crotoneæ*. It has been highly lauded by Dr. Gordon, Surgeon to the 10th Regiment of Foot. He writes,—

> "The success and rapidity of effect of the kameela in removing tape-worm in the cases of soldiers of the 10th Regiment, to whom I administered it, were such that I did not consider it worth my while to keep notes of them after the first two or three; nor, indeed, were the men to whom it was administered latterly taken into hospital, for they soon became aware of the wonderful efficacy of the remedy, asking of their own accord for a dose of it, after which they invariably parted with the worm in the course of a few hours, and then went on with their military duty as if nothing had happened; while, as I afterwards ascertained, considerable numbers did not think of 'troubling the doctor at all,' but, on suffering from the characteristic symptoms of the worm, applied for the kameela to the apothecary, and always with the same effect.
>
> "We prepared a spirituous tincture by adding Oj. of alcohol to ℥iv. of the powder, and then filtering. We never succeeded in obtaining more than ℥vj. in this way; and of this ʒj. in a little mint-water was generally found to be a sufficient dose, ʒij. being in some cases required, and perhaps in one or two, ʒiij., but I have never seen the remedy fail in removing the worm in a case where there were unequivocal symptoms of its presence.
>
> "With kameela there is no unpleasant effect. It is not even necessary to take a dose of purging medicine as a preparative; and beyond a trifling amount of nausea and griping in some instances, no unpleasant effects are experienced; while by far the greater number of persons to whom it is administered suffer no inconvenience whatever, beyond what they would from a dose of ordinary purging medicine" (*Med. Times*, 2d May, 1857).

One to three drachms of the powder, suspended in gruel, mucilage, treacle, or syrup, will of itself expel the worm.

The duration of the parasite varies from a few months to thirty-five years (WAURUCH); and although it is considered by some absolutely necessary that the *head* of the animal should be expelled before the treatment can be considered successful, yet there are good grounds for believing that there is considerable chance of destroying the parasite if large masses near the head are brought away. The worm is then likely to perish; the most actively growing and important portions being discharged. The head of the worm ought always to be sought for during treatment; at the same time, not being easily found, the physician is not to be discouraged by not finding it. Out of 100 patients treated for *Tœnia* by Bremser, he only once found the head in the dejections; yet all are said to have been cured.

FLUKE-LIKE PARASITES—*Trematoda.*

Definition.—*Parasites of a flattened oval form, smooth, soft, and yellowish, or yellowish-brown, and not jointed nor segmented. They are provided with two discs; one, situated at the pointed head extremity, forms a funnel-shaped depression leading to the oval orifice of a ramifying or bifurcating alimentary canal, which has no anal aperture. The other disc is situated on the abdomen, and terminates by a blind concavity. The opening of the sexual organs lies between the two discs. Male and female sexual organs are embodied in one and the same individual; and* (*as in parasites generally*) *they pervade a very large portion of the body of the mature adult animal.*

Pathology.—A study of these parasites is of practical importance chiefly in relation to their ova and early embryotic forms, which are now known to be developed in the open waters, or in minute water animals. It is therefore incumbent on us to be able to recognize them, and to know something of their natural history. The generation of some of these *trematode* parasites constitutes one of the most remarkable parts of the history of the process of reproduction among the *Invertebrata.*

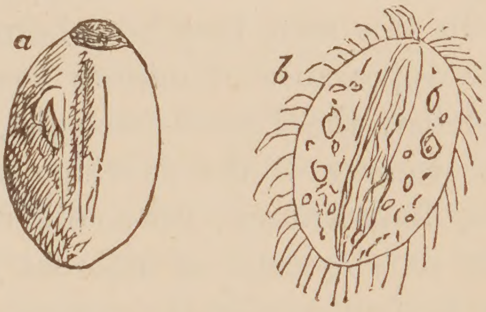
Two states or forms are known to exist—namely, a mature and an immature form—encysted and free.

(1(Distoma gives ova
(2/ opalina do
(3) germ cells formed inside 2
(4 (do inside 3 forming alepted cercaria of mussels of freshwater
(5(unciled oval bodies out of wh monostoma [illegible] of water [illegible]
(6(Embryo free passes into water & seeks larvae of shells
(7) tail embryo of young cercariae wh enter mammal

It is only in the mature form that the generative organs are found. Such mature *Distomata* have their *habitat* in the biliary passages, especially of the *Ruminantia*, as well as in man. Among sheep the disease induced by *Trematodes* often commits great devastation, and is commonly known by the name of "*the rot.*"

Self-impregnation and copulation are both possible in these parasites. It is only very recently that the facts connected with the natural history of these parasites have been ascertained, and their general result may be stated as follows:—The fully grown and sexually mature *Trematodes* (as exemplified in the *Distomata*) are parasites of the higher *Vertebrata*, and are oviparous.

When the egg of the *Distoma* opens (by the springing open of a sort of hood, which gives it the operculated appearance at one end), it gives vent to an embryo which moves rapidly by means of cilia, as is the case with many infusoriæ, and especially of the *Opalina*, now regarded by Schultze, Agassiz, and Stein as the earliest embryonic form of a *Distoma*. The discovery was made by Agassiz that a genuine *Opalina* (fig. 17, *b*) was hatched from the egg (fig. 17, *a*) of the *Distoma*. As such, they are found in sewage water (see A. H. Hassall's *Reports on the Water of London*); also in the fæces of animals infested with liver flukes, their ova passing out with the bile. They die in pure water, as many vermicular animals do who would be more fortunate in water which is dirty, full of organic impurities, and abounding in food fitted for them. (2/



Egg of Distoma. Opalina.

Fig. 17.

From each of these ova is formed an embryo, in which no resemblance to the parent *Trematode* is to be recognized; but presenting the simple structure of a ciliated animalcule, like a polygastric infusorian known as the *Opalina*. This embryo is not itself converted by any direct process of development or metamorphosis into a perfect *Distoma*, but has a progeny gradually formed from germ cells within it, and consisting sometimes of one, but more frequently of a number of bodies which, when they arrive at maturity, present each one an external form and (3) internal structure and locomotive powers entitling them to be considered as independent animals. Nor are these directly (3) converted into *Distomata;* a new progeny of animals is formed as before, nearly similar to those producing them, and equally differing from the complete *Distomata.* Each individual of this new progeny, as it increases in size, has formed within it, by (4) development from germ cells, the third progeny of the series and last of the cycle. These are different from their immediate parents, and in their internal organization soon manifest the type of the true *Trematoda.* They are endowed for a time with very active locomotive powers, to which a long caudal appendage contributes. Their progenitors have been confined in the parasitic condition, but these are in general freed from confinement, and move about with great vivacity for a time in the water surrounding the animals which their progenitors infested.

In this state they have been long known as *Cercariæ,* having the appearance of minute worms with tails, and were classed by Mueller, the Danish zoologist, with the *Infusories.* Regarding the history of the development of these animals, information is only fragmentary; yet so different periods have been observed in the development of different species of these *Trematodes,* that by analogy a tolerably connected history has been obtained of the whole process.

These *Cercariæ* in water are observed to be exceedingly lively and active, both as to body and tail; and after moving about free in the water they begin to go through a metamorphosis of a most extraordinary kind. They either become enclosed like a chrysalis in a pupa case, or, penetrating the bodies of soft animals, or embryos of animals, inhabiting the water—*e. g.*, snails, fish, larvæ of insects, and the like—they become encysted within these bodies. They thus become parasites, for example, in the mussel family (*Mytilus edulis*); in the ovisacs of the *Gammarus*, or sandhopper (a small crustacean abounding on our sandy shores), and which may be seen leaping up in myriads from the beach; also in snails, frogs, newts, and the like.

In the cavities of these animals it lives as a ciliated animal, and multiplies by division of its body.

(5) The next change in these parasites is that the cilia vanish. They fix themselves, and become by and by oval motionless bodies (Steenstrup, Pritchard, p. 270), which continue to grow,

and in which a germinal mass becomes visible, of an elongated form, and out of which the first form of a *Cercaria* arises. It is a single-mouthed parasite, and is known as the *Monostoma mutabile,* inhabiting the intestinal cavity of water birds.

In the interior of this parasite arises another embryo, which becomes free, and passes out of the bird into the water again; and being yet furnished with cilia, it makes its way especially into the aquatic larvæ of insects—*e. g.*, ephemera, caddice worms (*Phryganidæ*), the dragon-fly (*Libellulidæ*); and into the soft embryos of fishes like those of the cod kind; in snails, mussels, and such kinds of water animals, all used as bait and food for fishes.

Out of this ciliated embryo a *germ pouch,* as it has been called, makes its way; and from this germ pouch the *Cercariæ* broods are developed. In the eyes of fishes they inhabit the aqueous humours. Thus it seems probable that *Distomata* enter the human intestinal canal as *Cercariæ,* and pass thence into the biliary passages (FRERICHS); and according to the observations of Giesker and Frey, they may also penetrate directly into the skin, and undergo development in the subcutaneous cellular tissue. Two *Distomata* were found in the interior of a tumor on the sole of a woman's foot; and in all probability, as Frerichs remarks, the *Cercariæ* had entered the sole of this woman's foot while she was bathing in stagnant portions of the lake at Zurich. In another instance it was found in a cyst behind the ear of a sailor aged thirty-nine, and in an abscess in the head of a boy twenty-five months old (Murchison in Translation of Frerich's *Diseases of the Liver,* vol. ii., p. 488). The eating of uncooked fish, whelks, shell-fish, and uncooked garden snails, are all obvious modes in which the *Cercariæ* of the *Trematoda* may find an entrance into the bodies of man and other animals.

Nine species of the fluke-like parasites have been found in man. They have been named as follows:—

1. *Fasciola hepatica,* or *Distoma hepaticum,* in its full-grown condition, measures from eight to fourteen lines in length, and from three to six lines in breadth.

2. *Distoma crassum.*—In 1843 Mr. Busk found fourteen of these *Distoma* in the duodenum of a Lascar who died on board the "Dreadnought" hospital ship in the Thames. They are thicker and larger than those of the sheep, varying from one and a half to nearly three inches in length.

3. Of the *Distoma lanceolatum* only two instances are known of its occurrence in man.

4. Of *Distoma ophthalmobium* it is recorded that four specimens have been found in the eye of a child five months old, born with lenticular cataract. No one of them exceeded half a line in length; and they were situated between the lens and its capsule, where they could be recognized as so many dark spots on the surface of the lens (Cobbold).

5. The *Distoma heterophyes* was found by Dr. Bilharz, of Cairo, in 1851, in the small intestine of a boy; and on a second occasion he collected several hundred specimens under very similar circumstances. The parts infested displayed a multitude of reddish points, due to the presence of dark-coloured ova in the interior of the worms. The length of the largest specimens did not exceed three-fourths of a line (Siebold, Cobbold).

6. *Bilharzia hæmatobia* is so named by Dr. Cobbold in honour of its distinguished discoverer. It is, however, a bisexual parasite. The body of the male is thread-shaped, round, white, and flattened anteriorly. The oral sucker is triangular; the abdominal sucker at the end of the trunk is circular. Below this, at the curved margin of the abdomen, a furrowed canal exists for the reception of the female. This canal is peculiar and distinctive, and renders this *Distoma* generically distinct from the *Distomata* already noticed. The genital pore lies between the abdominal sucker and the commencement of the *canalis gynæcophorus*. The female is very thin and delicate; its tail is not provided with any canal. The suckers resemble those in the male; but the genital pore and the abdominal sucker are in contact. The length of the animal amounts to three or four lines, and the male is broader than the female (Frerichs, Murchison, Cobbold). Another name has therefore been given to it—namely, the *Gynæcophorus hæmatobius* (Diesing); but by whichever name it is known, it is of remarkable interest, not only from its peculiar anatomical structure, but from its great prevalence on the borders of the Nile, and from the grave and characteristic symptoms and appearances to which it gives rise. According to Griesinger it is met with in Egypt 177 times in 363 *necropsies*—*i. e.*, equal to 33 *per cent.*

The first specimens were discovered by Bilharz, of Cairo, in the portal vein and its branches, and likewise in the walls of the urinary bladder. It has been since observed by Griesinger, Reinhart, and Lautner in the veins of the mesentery, urinary bladder, ureters, and pelvis of the kidney, giving rise to a formidable and very prevalent disease. In the larger vessels, such as those of the liver, this *Distoma* gives rise to no derangements equal to those which result when it exists in the lining membrane of the urinary passages and the intestinal canal. There it induces hæmorrhage and inflammation. In the intestine they are often associated with appearances resembling those of dysentery, with congestion, extravasation of blood, deposit upon and beneath the mucous membrane, fungoid excrescences, and croupy exudations that occupy ulcerated patches of the bowel. In many of these cases the eggs of the creature may be found wedged in long rows within the intestinal vessels, or in and beneath exudations on the free surface of the mucous membrane. Hence it was suspected whether the dysentery endemic to Egypt might not have to the presence of these *Distoma* the same relation as the itch has to the *Acarus*.

Such a conclusion receives a strong confirmation when we turn to the lesions produced in the urinary apparatus. Here the mucous membrane appears swollen in places which are covered with a soft, sandy, rotten mass, that is firmly fixed to the subjacent tissue. The microscope shows this mass to consist of the full and empty shells of the parasitic ova, imbedded in a mixture of blood, exudation, modified epithelium, and crystals of uric acid. The thickening of the submucous tissue often produces stricture of the ureter, which is followed by retention of urine and all its dangerous consequences,—degeneration of the kidneys, pyelitis, dilatation of the pelvis, or atrophy of the renal substance; or the masses themselves become the nuclei of calculous deposits, and thus aid in the chlorotic exhaustion these creatures produce in the person they inhabit, by the consumption of blood they imply. Lastly, it seems not unlikely that the dislodgment of clots into the general circulation sometimes brings about pneumonia, in the way described by Virchow, and illustrated by the clinical researches of Kirkes (*Brit. and For. Med.-Chir. Review*, l. c., p. 125). Professor Virchow was good enough to show me a specimen, in his museum, of lesions in the bladder effected by the existence of this *Distoma*. The entire trunk of the portal vein is sometimes filled with this parasite, while their ova are found in the tissue of the liver; but the symptoms to which the *D. hœmatobium* gives rise are more referable to the urinary organs than to the liver. The urine is bloody, and sometimes contains the ova of the *Distoma;* and a state of profound cachexia supervenes (Frerichs, Cobbold, Moquin-Tandon). Dr. John Harley, of King's College, London, has recently directed the attention of the profession in this country to the remarkable prevalence of *hœmaturia* at the Cape of Good Hope—a condition which he found associated with the fertile ova of this entozoön passed in the urine. After micturition, a little blood, never exceeding a tea-spoonful, or some dark coagula, like "veins," appear with the last half-ounce of urine. The urine itself is never bloody. Sometimes the blood-coagula will block up the urethra, and cause obstruction for a few minutes. These are all the symptoms which appear in connection with the urinary apparatus; and numbers of people of both sexes are affected in precisely the same way in certain parts of the Cape—as endemic hæmaturia—especially at Uitenhage and Port Elizabeth. In various samples of urine sent to him by a person suffering from this affection, he invariably detected the ova of the entozoön. Of these he was kind enough to give me specimens, and a copy of the wood-cut (fig. 17 A). He was successful in observing the perfect ciliated embryo after its escape from the shell.

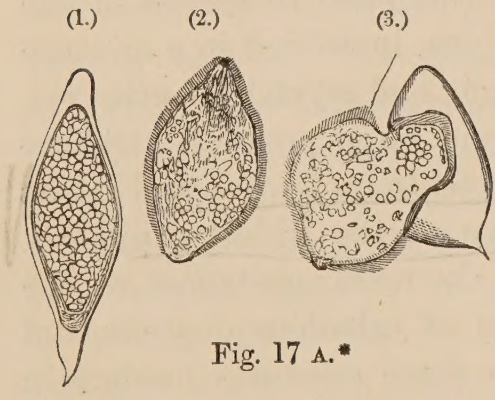


Fig. 17 A.*

Dr. Cobbold has discovered the same *Distoma* in the portal system of an African monkey.

7. The *Tetrastoma renale,* as its name implies, infests the tubes of the kidney, and was discovered in 1833 by Lucarelli and Della Chiaje. It attains a length of five lines, has an oval, flattened body, and is furnished with four suckers disposed in a quadrate manner at the caudal extremity. The reproductive organs are situated near the mouth.

8. *Hexathyridium pinguicola* was once found in a diseased ovarium. The parasite attains a length of eight lines (Treutler, Owen).

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* (1.) Ovum of *Distoma hœmatobium* from hæmaturia of the Cape of Good Hope (Dr. John Harley); (2.) Embryo (ciliated) from ovum capsule; (3.) Embryo attached to the ovum capsule.

9. *Hexathyridium venarum* has been found in venous blood, and from the sputa of persons suffering from hæmoptysis (TREUTLER, CHIAJE, FOLLINA). It attains a length of three lines, is cylindrico-lanceolate, with six suckers biserially disposed on the under side of the so-called head (COBBOLD).

Symptoms.—The symptoms to which *Distomata* give rise in the human subject must of course vary with the site of the parasite; but nothing definite is known regarding them, except in the cases of *hæmaturia* and *dysentery*, already noticed. In sheep their presence occasions dilatation and catarrh of the biliary passages, accompanied by atrophy of the hepatic tissue. Jaundice rarely shows itself, and then only lasts a short time; but ultimately a condition of anæmia is developed, under which numbers of sheep die. The disease is known as "the rot" among sheep; and it prevails to a considerable extent among flocks feeding on marshy and wet land near the shores of rivers.

In the human liver bodies have been found like the ova of entozoa, so frequently met with in the liver of rabbits (GUBLER, quoted by FRERICHS).

ROUND WORMS—*Nematelmia.*

Definition.—*Parasites of an attenuated and cylindrical form, having an intestinal canal suspended freely in a cavity of their bodies. They are possessed of a mouth and anus, and have the sexes distinct.*

Pathology.—In their mature state these worms inhabit the alimentary canal, the pulmonary tubes or areolar tissue of man and animals. In their immature state some are encysted in the human body, and others come to maturity in the open waters. In the human subject they are represented by the *Ascarides*, the *Oxyurides*, the *Trichinæ*, the *Sclerostoma*, the *Strongylus*, the *Speroptera*, and the *Filariæ*.

1. The *Ascaris lumbricoides*, or round worm, is perhaps the most anciently known, and is the most common of human entozoa. It is now regarded as specifically distinct from the *A. megalocephala* of the horse and the *A. suilla* of the hog (DUJARDIN, MOQUIN-TANDON, COBBOLD). It is much more common in children and adults than in old people. The body is long (six to sixteen inches), round, elastic, and attenuated towards

both extremities, but more attenuated towards the anterior end. It is of a greyish red colour, and sufficiently translucent to permit its viscera to be seen through its coverings. The *Ascarides* inhabit chiefly the small intestines, but may pass up into the gall-ducts, the stomach, the œsophagus, the nostrils, the mouth, or frontal sinuses; and there are cases on record and specimens in museums where the worm has evidently penetrated the coats of the intestine, and got into the peritoneum or into the pleura. It sometimes makes its way by the bile-ducts into the liver, and leads to hepatic abscesses. An interesting example of this may be seen in a preparation in the museum of the Army Medical Department at Netley. In some cases they are so numerous as absolutely to obstruct the intestines; in others only a solitary worm, or a pair, may be found. Three distinct tubercles surround the mouth and characterize the genus. The posterior end is obtuse; but is straighter and thicker in the female than in the male. It is abruptly acute and curved in the male. An anus is situated in both sexes close to the tail, and in form is like a transverse fissure. In the female the body presents a constriction at the junction of the anterior with the middle third; and here the *vulva* is situated. The parasite throughout is marked with transverse furrows and with fine striæ. Longitudinal equidistant lines run from the head to the tail, and are independent of the exterior envelope.

2. The *Ascaris mystax*, which infests every domestic cat, must now be regarded as a human parasite (PICKELLS, BELLINGHAM, COBBOLD). It varies from an inch and a half to two or three inches long, its head end being spear-shaped, in consequence of two lateral processes, from which it has been named *A. alata*. The ova have the embryo developed within them before they escape from the parent, and in this respect they resemble the *Oxyuris vermicularis*. (See description of the *Oxyuris vermicularis*.)

3. The *Trichocephalus dispar* occurs in the cœcum and colon. and was first noticed by Morgagni. A little more than a hundred years ago (1760-61) a student of Gottingen was dissecting the valve of the colon of a girl five years of age. He accidentally opened the gut, and several of these entozoa came out. Wrisberg and other students considered the worm a new one; but the demonstrator of anatomy maintained that it was an *Ascaris* or

an *Oxyuris*, and a dispute arose. At last the new parasite got a name as a new worm, and was called a *Trichinalis* or *hairtail.* But it afterwards turned out that its *head* was hair-like, and not its *tail*, so it has been since called *Trichocephalus.* About this same time an epidemic raged in the French army stationed at Gottingen, and was described under the name of the *Morbus mucosus;* and this entozoön was frequently found in the bodies of the soldiers who died of this disease.

It is said to be very common in persons attacked with typhus fever; and is found in those dying with excessive discharges from the bowels, as in cholera and diarrhœa.

It is found in France, England, Egypt, Ethiopia, and rarely in Italy; abounding particularly in the caput cœcum. It is generally thought to be scarce in England—a persuasion which Dr. Cobbold thinks has probably arisen from "the negligence of pathologists, whose arduous duties connected with the superintendence of *post-mortem* examinations have, perhaps, left them little time for these inquiries." On the other side of the Channel this parasite is so abundant in some localities that not less than one-half the inhabitants of Paris are affected by it (DUVAINE).

These parasites are males and females, in separate sexes, varying from $1\frac{1}{2}$ to 2 inches.

The anterior extremity, carrying the head, is the narrow hair end, and it is usually buried in the mucous membrane of the intestines, while the remainder of the body moves freely in the midst of the mucous secretion, generally coiled upon itself.

The males are shorter than the females, and less thick posteriorly, with a long spiculum. The eggs are oval, with resisting shells $\frac{1}{110}$th of an inch in length.

Generation of Round Worms.—The generative organs of these nematoid worms are adapted for the reproduction of an enormous number of fertile ova. They are male and female; but the males, as a rule, are scarcer and smaller than the females.

The fertility of these animals is enormous. Dr. Eschricht has made an elaborate calculation regarding the *A. lumbricoides*, the commonest parasite of man. The ova being arranged like flowers upon a stem in the ovary tubes, he has counted fifty in a circle, or in every transverse section. The thickness of each ovum he estimates $\frac{1}{500}$th of a line (= $\frac{1}{500}$th of $\frac{1}{12}$th = $\frac{1}{6000}$th of an inch); so that in every line of length of the worm there would be 500 wreaths of 50 eggs each, = 25,000 eggs.

The length of each horn of the uterus is taken at sixteen feet, which gives 2,304 lines; and for the two horns it will give 4,608 lines. The eggs, however, gradually get as large as $\frac{1}{60}$th of a line, so that only sixty wreaths of eggs come to be on one line, or about 3,000 ova; and an average gives 14,000 ova in a line—*i. e., sixty-four millions of ova in every mature female Ascaris.*

What becomes of all these ova? The embryo is not developed within the body of all of these parasites; and the source of the various *Ascarides* which inhabit man is not yet fully known.

The ova being discharged by millions, many of them in large cities will be carried into streams of water. An extremely small proportion is ever likely again to find their way into the alimentary canal of the animal which was the dwelling-place of the parents of these ova. Thus they become food for numerous minute inhabitants of the water, and therefore stand in the same relation to many of these animals as the *cerealia* in the vegetable kingdom to the higher animals. Indirectly they thus contribute to the sustenance of man and animals.

But on the other hand there are many circumstances which tend to show that the *A. lumbricoides* is most frequently introduced as a minute embryo with water or with fresh uncooked vegetable food.

Dr. Paterson, an eminent physician in Leith, observed that certain families who drew water from a public well in a particular street there, were very subject to the *A. lumbricoides;* while towards the other end of the same street the families were supplied by the pure water which supplies Edinburgh and its vicinity; and these families were free from the parasite. The water of the well came from a dirty pond or lake in the vicinity (called Lochend), and in its water numerous vermiform animalculæ existed, such as the *Anguillula fluviatilis,* perhaps the embryonic form of an *Ascaris.*

Another point to be remembered in all inquiries of this kind is the intense tenacity of life, and revival from a state of apparent death exhibited by these parasites; and in no class of animals has the origin by spontaneous generation been more strenuously contended for than in regard to these entozoa. For example, there is a minute worm of a nematoid kind which is a parasite upon wheat grains (the *Vibrio tritici*); some of these being dried, and then remoistened after a lapse of four to seven days, they resumed their living active state (Bauer in *Phil. Trans.*, 1823, p. 1, quoted by Owen). Dr. Blainville has given other similar instances of revival after desiccation; and mature entozoa will even resist the effects of such destructive agents as extremes of heat and cold, to a degree beyond the endurance of any other minute animals. Owen relates that a nematoid worm has been seen to exhibit strong contortions—evident vital movements—after having been subjected above an hour to the temperature of boiling water with a codfish which it infested. Rudolphi mentions of some entozoa which infest herrings annually sent to Berlin hard frozen and packed in ice, that they do, when thawed, exhibit unequivocal signs of restored vitality (Owen, *Lectures on the Invertebrata*, p. 80). *Ligulæ* are often found alive in undercooked codfish. Rudolphi found individuals of *Ascarides* (*spiculigera*) stiff and hard in the gullet and stomach of a bird (*cormorant*) kept in spirits of wine for eleven days, and which returned to life in warm water. Miram has seen individuals of the *Ascarides* (*acus*) from the pike become dry, and remain sticking to a board, where they would revive again by being placed in water, and in some instances they would move a part of the body which had imbibed the fluid, while the remaining part continued shrivelled up, and adherent immovably to the board. I have seen the very same results in the *Ascaris* which infests the peritoneal covering of the mackerel. Such being the tenacity of life on the part of the mature animal, how much more do the ova possess the powers of endurance? Without losing latent life, they even develop themselves under circumstances of the most improbable kind. Dr. Henry Nelson and Dr. Allen Thomson have observed the development of the ova of the *A. mystax* to proceed for several days, while the parent bodies containing them were immersed in oil of turpentine. I have once seen the same occurrence; and also I have seen the development of the embryo proceed in spirits of wine for about three weeks before signs of vitality had ceased.

Periods of Incubation of the Ova.—The eggs are ovoid, and covered by a transparent envelope or chorion, which after fecundation and segmentation *becomes tuberculated.* Hence the various accounts given as to their surface appearance. They are expelled with the fæces in the case of the *A. lumbricoides.* They have been placed in water and taken care of for various lengths of time, and Richter records that at the end of eleven months each ovum contained a living embryo. In August, 1853, Verloren and Richter put a fragment of a mature female *Ascaris* (*marginata* of the dog) into water, so as to keep the ova moist merely; and he examined them from time to time with the microscope. Segmentation having commenced, the development of the young was completed in fourteen days. They moved with great briskness within the egg-shells, *but did not break through them.* In this imprisoned or encysted state they continued throughout *autumn* and *winter;* the movements of the embryos gradually diminishing and at last entirely ceasing during the winter months, to recommence in the following spring, and become again distinct in summer; *but they never broke through the shell.*

The condition of these *Ascarides* from the encysted state of enclosure within the egg is only changed under favourable circumstances — namely, when the animals are liberated and carried on to further development; and now it is known that the embryo of nematoid worms may pass the winter in a torpid state, floating about in the open waters, or lying in moist places. The fully formed embryo is cylindrical, its length $\frac{1}{100}$th of an inch; the mouth is not furnished with the three characteristic papillæ of the genus, and the tail terminates suddenly in a point. It is highly probable, from the evidence, that the embryos are directly transferred to the alimentary canal of man from river and pond-water.

4. *The Oxyuris vermicularis* was known to Hippocrates, and is one of the most troublesome parasites of children, and occasionally of adults. It is a minute, white, thread-like worm, the male being about a line and a half in length, and the female five or six lines. They inhabit chiefly the rectum, where they are often found in clusters, rolled up in balls of considerable size, and from the rectum may creep into the vagina or urethral orifice. Sometimes they give rise to profuse and exhausting bloody discharges from the vagina.

The eggs of this parasite have embryos developed within them *prior to their escape from the parent;* and in this respect they differ from the *A. lumbricoides* and the *Trichocephalus* on the one hand, and from the viviparous *Dracunculus* on the other. In this character, however, they resemble the *A. mystax.*

In all probability the young escape from the eggs soon after the latter are expelled or migrate *per rectum*, and, like others of the *Nematelmia*, gain access to the human body with our vegetable food or water whilst still in a sexually immature condition.

5. The *Trichina spiralis* was first seen by Tiedemann in 1822, and was first described by Mr. Owen in 1835 from a specimen taken to him by Mr. Paget. It has since been often recognized chiefly as a dissecting-room curiosity. The student tries in vain to clean the fibres of the muscle he is dissecting, which, however clearly displayed, still looks as if it were "sprinkled over with the eggs of some insect."

Instances of the *T. spiralis* in the muscles of the human body are of much more frequent occurrence than has generally been supposed. Most probably, from their very minute size, they have hitherto been overlooked. Virchow had not seen a case before 1859, after which he met with no less than six in one year. It is perhaps more common in man than even the *Cysticercus*. Zenker, of Dresden, found *Trichinæ* in four out of 136 dissections—*i. e.*, one in thirty-four.

Of late, however, much interest has been excited in this subject; for, in place of the *T. spiralis* being quite a harmless parasite, as has been hitherto the belief, Zenker has lately shown that it is the source of a new and most alarming form of disease; that, in place of remaining harmless and encysted in its capsule, only to cretify or degenerate, it may free itself from this cyst, and, migrating amongst the muscles, may give rise to symptoms of the most serious kind, causing death in a strong and healthy person after a few weeks of painful suffering.

It seems, indeed, to be the most dangerous of all parasites—not even excepting the *Echinococcus;* and it behoves the physician to know something about the nature, origin, and development of this entozoön, seeing that its pathological relations are now known to be of extreme importance and interest.

The *T. spiralis* has been hitherto known as a minute round worm, enclosed in a more or less transparent capsule, lying between the sarcolemma of the primitive muscular fibres (figs. 18, 19); but when the parasite is free, it finds its way within that sheath. It forms the type of a distinct genus of *nematodes*, having no genetic relations with the *Trichocephalus dispar*, as was supposed; but is reproduced viviparously. The non-encysted

Trichina may exist in the flesh of animals without being visible to the naked eye. In the encysted state they are difficult of detection without the aid of a lens, if cretification has not commenced in the cyst. The cysts are round or elongated, and appear, according to their shape, like small round dots, granules, vesiculæ, or streaks, greyish-white or opaque, and quite distinct from the red transparent muscle. When the cyst has become calcareous, its limy material may be dissolved away by acetic or hydrochloric acid with the evolution of gas, and the parasite is then seen coiled up within (fig. 18).

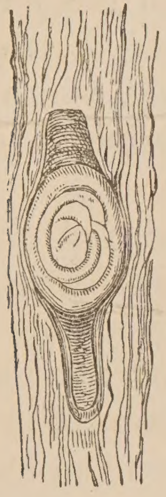

Fig. 18.*

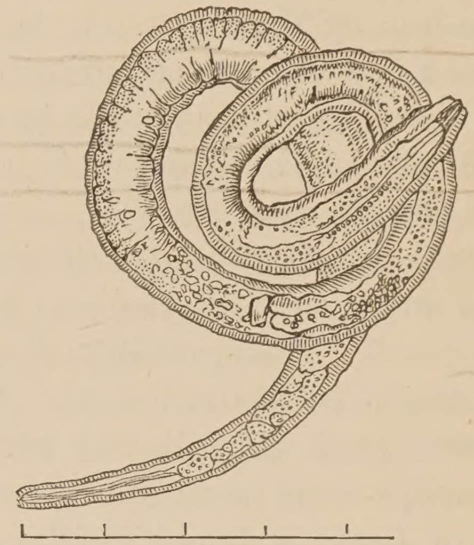

Fig. 19.†

The symptoms of the disease induced by this parasite are at first of a febrile nature, having a close resemblance to some forms of specific fevers. Dr. Philip Frank, lately Assistant-surgeon on the staff of Her Majesty's Army Medical Department, was the first to send an account of this remarkable disease from Germany to this country. He described a case of its occurrence in the *Medical Times and Gazette* of May 26, 1860; and recently Dr. Parkes has given a short notice of *trichina disease* in the *Sanitary Report of the Army Medical Department* for 1860, p. 351. The history of the case referred to by Dr. Frank is as follows :—

In January, 1860, a servant girl about twenty years of age died in the Dresden Hospital from the effects of the *T. spiralis;* and the muscles of her body furnished materials for

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* Slightly magnified cyst of *Trichina spiralis* (after VIRCHOW).

† The *Trichina spiralis* removed from its cyst (after VIRCHOW).

(1) Typhoid Symptoms
(2) Pain in Muscles of Xties

numerous observations and experiments, which have thrown much light on the origin and development of this parasite. The illness of the patient commenced about Christmas, 1859; and the symptoms may be arranged into two sets,—(1.) Extreme lassitude, depression, sleeplessness, loss of appetite, and eventually febrile phenomena which were well expressed, so much so, that the case was set down as one of typhoid fever; but grave doubts prevailed, for (2.) A new train of symptoms developed themselves—namely, the whole muscular system became the seat of excruciating pain, especially in the extremities. Contractions of the knee and elbow joints supervened, and associated with such extreme pain as to render extension of the limbs impossible. Œdema of the legs followed; and the case terminated fatally by pneumonia, about the twenty-eighth or thirtieth day after the first symptoms of illness.

A *post-mortem* examination of the body showed the muscles moderately developed, of a pale reddish-grey colour, and dotted over with specks, which turned out to be groups of non-encapsuled *Trichinæ*, lying free upon and within the sheaths of the muscular fibres. They were alive—some coiled up and others lying straight; and they appeared to be in all stages of development, diffused throughout all the striated muscles of the body, not even excepting the heart itself. They abounded in such vast numbers that as many as twenty *Trichinæ* were seen in the field of view through a low magnifying power, the muscular tissue being everywhere in a degree of very marked degeneration. In the jejunum were found sexually mature *Trichinæ*. Death was due to the development of the *T. spiralis*, whose existence fully explained the anomalous symptoms which attended the case.

On looking into the history of the girl it was found out that she had been a servant in a farm-house, and had been taken ill very soon after the killing of two pigs and an ox—animals which it is customary to kill about Christmas.

Pigs are known to be infested with the *T. spiralis*—so are oxen; and Professor Zenker went to the master's house, and found some ham left of the identical pig that had been there killed, and also some sausages. The flesh of the pig was examined microscopically, and every specimen examined showed that the pig's flesh was infested with *Trichinæ* in the encysted state. At the same time Professor Zenker learned that, soon after the girl had been taken ill, the housekeeper became unwell, with similar symptoms, but in a less severe degree ; and all the servants about the farm became more or less ill about the same time. The house of the butcher who had killed the pig was then visited by Professor Zenker, who was informed by the wife of the butcher that he had been very ill since that event. He had been three weeks in bed, suffering from *rheumatic pains in the limbs,* and had been as if paralyzed over his body—unable to move his arms, legs, or neck. He had never suffered anything of the kind before, but had always been a healthy and strong man. He thought he had caught cold the day he killed the pig; but when it is known to be a habit of German butchers to taste the meat they kill, in the raw condition, the history of these cases, to Professor Zenker, became a history of *trichinatous disease*—the development and growth to maturity of the *T. spiralis* in the muscles of those who lived at the farm-house, as well as of the butcher who had killed the pig, and who no doubt had eaten some of its flesh.

Numerous experiments were made with the flesh of the girl who died in this remarkably morbid state. Portions of the flesh were sent by Zenker to Professor Virchow at Berlin. He fed a rabbit with some of it, and this rabbit died about a month after the feeding, with symptoms of general muscular paralysis, and myriads of young *Trichinæ* were seen in its muscles. Other rabbits were fed with the flesh of the first rabbit, and they too died with similar phenomena.

Another observer had before made similar experiments. Herbst, in 1852, fed three young dogs with the flesh of a badger whose muscles were saturated with *Trichinæ.* The dogs in their turn became *trichinatous;* being killed after a few months, the parasites were seen in their flesh. Pigeons also were fed with moles' flesh known to be *trichinatous;* and free *Trichinæ* were found in the flesh of the neck, the wings, and the thighs of the pigeons in eighteen days. But Herbst did not examine into the relation between the capsuled and the free *Trichinæ,* as Virchow and Zenker have done.

The *Trichina spiralis* is now well known not to be limited to the muscles of man. It occurs in eels, cats, dogs, badgers, hedgehogs, pigeons, moles, and swine.

Virchow found the villi of the intestines of the rabbits loaded with the ova or *prospermiæ* of the entozoa; and he found mature *Trichinæ* of *both sexes* moving freely in the mucus of the intestine. The males were filled with sperm corpuscles, while the females were densely stocked with ova and their germs, and with young ones in the eggs, coiled up like little snakes.

In the summer of 1860 a subject was received into the dissecting-room of the University of Edinburgh; and the muscles of that subject contained numerous flesh-worms. Dr. Turner, the demonstrator of anatomy, then took the opportunity of verifying the experiments of the German professors. He fed kittens with portions of the human flesh containing the worms, which were observed to move, though somewhat languidly, on rupturing the cysts. To one cat on the 7th, 13th, and 16th of July he gave portions of the flesh, and in the intervals fed it on bread, milk, and fish. He killed the cat on the 24th of the month. Nothing could be seen with the naked eye in the fluid of the small intestines; but on placing a drop below the microscope, thread-like worms were seen actively moving about in it, or coiling themselves up in a spiral form. Every drop of fluid taken contained one or more. Each of these thread-like worms was about $\frac{1}{40}$th of an inch long and $\frac{1}{1000}$th of an inch broad, with a pointed and a rounded end, and about two-thirds smaller than the mature flesh-worms met with in the muscles of the cat. These had migrated from the intestines, and after working their way between the fibres of the muscles, had become encapsuled—the capsules being perfectly transparent. Herbst and Virchow have found the flesh-worms both in the mesenteric glands and in the mesentery, and therefore, presumably, *in transitu* between the intestines and the muscles. All the phenomena described occurred within the space of a single month; and even as early as three weeks after feeding, Virchow found the young brood equal in size to those administered at the commencement. The genesis, development, and migrations of these flesh-worms are thus proven to be astonishingly rapid. Dr. Thudichum has also very recently verified these experiments; and at the conversazione of the British Medical Association, held at Downing College, Cambridge, on 4th August, 1864, he exhibited the parasite, *living*, in various stages of development, which he obtained from the muscle of a rabbit infested with them, and also from some pork chops (*Brit. Med. Journal*, August 13, 1864).

Thus the *T. spiralis* has been shown to be a bisexual parasite, producing its young alive in the intestines of the animal whose muscles it may infest, either in the free or in the encapsuled state. So long as it remains in the capsule it is immature and non-sexual, and so far they are harmless; but should they become free, they grow larger, and may become mature, and so give rise to others, if the death of the animal they inhabit does not occur.

In the mucus of the intestines the mature *Trichinæ* find a suitable place for growth and breeding, their progeny finding their way to the muscles, where they eventually become encysted; and their favourite haunt there seems to be the small muscles of the larynx (Zenker).

According to Virchow's conclusive testimony, all these phenomena occur within the space of a single month; and, in his experiments, even as early as three weeks after ingestion, the young were found to equal in size those that he administered at the commencement. The genesis and migrations of *Trichinæ* are therefore astonishingly rapid, and probably without parallel in this class of parasites (Cobbold).

Since the discovery by Leuckart of the round worm, of which the *T. spiralis* is the immature condition, since the case recorded by Zenker, and since the more complete knowledge that has been acquired by experiments, of the wonderful migrations of the young *Trichinæ*, attention has been especially directed to the possibility of the *trichinatous disease* in man being more common than was anticipated.

In December, 1860, Professor Wunderlich met with a case of prolonged fever, which did not correspond in its course with any of the well-known specific fevers. The patient was a butcher. He eventually got quite well, and so far negatived the diagnosis of *acute* tuberculosis which had been made. A second butcher, from the same establishment, came into the hospital with the same symptoms of high fever, with immense depression; but the course of the disease again did not correspond with any of the known fevers. Here, as in the first case, the muscles were particularly implicated, but in a less degree. There were ~~was~~ not only muscular pains, but absolute soreness of the muscles on pressure. This man, too, eventually got well. A third and a fourth butcher, from the same house, were also taken ill with similar severe febrile symptoms, but they were not seen by Wunderlich.

These men had been killing a number of pigs; and, as is the custom, they ate of the raw flesh. Eight men so ate, and four of them were afterwards attacked with these anomalous but severe febrile symptoms. Unfortunately none of the pork had been preserved, and the possibility of *Trichinæ* existing in it had therefore not been proven. Moreover, none of these men died, and no evidence of the parasite existing in their muscles was obtainable. But looking to the undoubted fact that the use of the raw meat brought on the disease, and to the great probability that the wanderings in large numbers of the *Trichinæ* will produce these symptoms, Professor Wunderlich deems himself justified in thinking that there are some grounds for considering these febrile attacks to have been due to *trichinatous disease.* That individuals enjoy good health although the muscles are infested with the encapsuled *Trichinæ* is now well known from the number of cases that have been seen in dissecting-rooms. Cases are also referred to by Mr. Curling, of its being recognized in the muscles of men killed by accident, when engaged in severe manual labour (*London Med. Gazette*, Jan., 1838; also Turner in *Edin. Med. and Surg. Journal*, 1860, p. 209). The distinguished teacher of clinical surgery at Berlin, Professor Langenbeck, related to the Medical Society there, in 1863, the case of a man from whom he had recently removed an epithelial cancer situated in the neck. During the operation the *platysma myoides* exhibited a singular appearance, which, on careful inspection, was found to arise from the presence in the muscle of innumerable dead *Trichinæ* contained in calcified capsules. On inquiry, the following facts were elicited:—In the year 1845 there was a "church visitation" (whatever that may mean), in which eight persons took part, and of these, seven afterwards sat down to a breakfast consisting of ham, sausages, cheese, roast veal, and white wine. In the course of three or four days every one of the seven persons was seized with diarrhœa, pains in the neck, œdema of the face and extremities. Of the seven, four died, and the three who survived (among whom was the man operated upon eighteen years afterwards by Professor Langenbeck) remained ill for long afterwards. The suspicion arose that poisoning, through the agency of white wine, had taken place; and an investigation was made, but without any result. The innkeeper, however, at whose house the breakfast was given, being still under suspicion, was obliged to give up his business and emigrate. The importance of such a case in its forensic aspects cannot be overrated; and it becomes an important subject of inquiry whether some of our cases of death from suspected but unproved poisoning may not be due to *trichina disease,* which is now known to be much more prevalent than has hitherto been supposed, both in this country and in Germany.

Very recently attention has been again awakened on the subject by an occurrence almost tragical.

About the middle of October, 1863, there was a festive celebration at Heltstädt, a small country town in Prussia, near the Hartz Mountains, numbering from 5,000 to 6,000 inhabitants. One hundred and three persons sat down to an apparently excellent dinner, mostly men in the prime of life. Within a month more than 20 persons had died, and more than 80 persons were then suffering from the fearful malady, while those who were apparently unscathed were in hourly fear of an outbreak of the encapsuled flesh-worms.

The dinner had been ordered at a hotel, and it was arranged that the introduction to the third course should consist of "Röstewurst." The sausage-meat was therefore ordered at the butcher's the necessary number of days beforehand, in order to allow of its being properly smoked. The butcher, on his part, went to a neighbouring proprietor of pigs, and bought one of two pigs from the steward of the pig-farm. The steward unfortunately sold a pig which his master intended should not be sold, because it was not considered to be in good condition. Nevertheless, for this time at least, the butcher got "the wrong sow by the ear." The ill-conditioned pig was the one that was killed and worked-up into sausages. These were duly smoked and delivered at the hotel; and after being toasted before the fire (so as to be warmed through merely) they were served to the guests at the dinner-table.

On the day after, several persons who had eaten the dinner were attacked with great irritation of the bowels, loss of appetite, great prostration, and fever. The number of persons attacked rapidly increased; so much so, that great alarm was felt in so small a town lest an epidemic of typhoid fever was about to set in.

But one of the physicians at last conjectured that some poison must be at the bottom of the outbreak, and an active inquiry into all the circumstances of the dinner was instituted; and when the

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muscles of the calves of the legs of some of the sufferers began to be affected, the descriptions of Zenker's case (already described) was at once remembered. The remnants of sausages, and of pork employed in the manufacture of them, were examined with the microscope, and found to be literally swarming with encapsuled flesh-worms. From the muscles of several of the suffering victims small pieces were excised, and under the microscope they were seen to be charged with *Trichinæ* in all stages of development. It could therefore no longer be doubted that as many of the 103 persons as had dined together and partaken of the "*Röstewurst*" were affected with trichinous disease by eating the trichinous pork, the flesh-worms of which had not been killed by the smoking and toasting. On the contrary, the subdued heat of toasting would rather foster their vitality.

This catastrophe awakened sympathy and fear throughout the whole of Germany. Most of the leading physicians were consulted in the interest of the sufferers; and some visited the neighbourhood where most of the affected patients were. None could bring relief or cure. Case after case died a slow and lingering death, by exhaustion from nervous irritation, fever, loss of muscular power, inflammation of the lungs, or of organs essential to life. The cases have been observed with great care and chronicled with skill. All the features of the remarkable disease have been registered in such a manner that hereafter there can be no difficulty in recognizing the disorder.

The disease begins a few days after eating the meat in which there were *Trichinæ*, with loss of appetite, and, almost without exception, with diarrhœa and fever; œdema of the eyelids; also pain, or at least painful sensation of weakness, in the limbs; œdema of the joints; difficulty in moving the tongue; profuse clammy perspiration: and those patients who do not become convalescent die either unconscious, with symptoms of typhoid fever, or, in a few cases, remain conscious to the end, complaining of inability to breathe freely.

The only important symptom of typhoid fever absent in the disease is the enlargement of the spleen; and it is very probable that some of the so-called epidemics of typhoid fever in former days were caused by the propagation of *Trichinæ* in the human body.

Since the disease has been known (about five years ago), a great many cases have been observed in Germany.

The vitality of the *Trichinæ* is not destroyed unless the meat or other substances in which they are located be subjected to the temperature of boiling water for a sufficient time to insure that every particle has been acted upon by that degree of heat. Salting, smoking, and toasting trichinous meat, as is usually done, does not appear to be sufficient to destroy the worms in all parts of the meat.

Picric acid (*acidum picro nitricum*) was tried, with the hope that it might be administered with success to the patient, but it failed. In trichinous pork of a pig killed with picric acid the worms were found alive (W. Müller, of Homberg).

When this flesh-worm was seen more than thirty years ago, it was little thought that the bit of muscle sent to Owen contained the germs of a disease which might be carried in a living pig from Valparaiso to Hamburg, and then kill almost the entire crew of a merchant vessel. It has been recently related that a pig so diseased was shipped at Valparaiso, and killed a few days before their arrival at Hamburg. Most of the sailors ate of the pork in one form or another. Several were affected with the flesh-worm, and died. One only escaped being ill. Numerous cases of fever, and epidemics of inscrutable peculiarity, are now claimed by medical writers, with much show of reason, as outbreaks of the flesh-worm disease.

Professor Eckhardt, of Giessen, has obtained permission to produce the disease in a criminal condemned to die, and to try various remedies on him. (For a very interesting account of *Trichinous* or Flesh-worm disease, the reader is referred to the recent work of Dr. Althaus on this subject.)

For the diagnosis of *Trichinæ* in the muscles of man, Kuchenmeister has proposed to *harpoon* the muscles; but this seems a very severe operation. Welcker believes that the best place to look for them is under the tongue, close to the frœnum: in cats they can be easily seen in this situation. Whether it is so in man is not yet known, (Virchow's *Archiv.*, 1861, p. 453, quoted by Dr. Parkes, l. c.)

6. The *Sclerostoma duodenale* is known to be tolerably common throughout Northern Italy; and, according to Pruner, Bilhartz,

and Griesinger, it is so remarkably abundant in Egypt that about one-fourth of the people are constantly suffering from a severe anæmic chlorosis, occasioned solely by the presence of this parasite in the small intestines.

"Its length is about one-third to half an inch, its width about one-twentieth of its length. Its head has a round apex, and its extremity, which is bevelled at the expense of its posterior surface, is provided with hooklets that occupy converging papillæ. The mouth contracts, to open into a thick muscular pharynx, which, widening as it passes downward, ends, after occupying one-seventh of the body, in the intestine. The sexual differences of the male and female are very interesting. Its pathological significance is chiefly due to the hæmorrhage caused by these parasites, which are often present in thousands between the *valvulæ conniventes* of the duodenum, jejunum, and ileum, and not infrequently in the submucous areolar tissue. In short, the physician practising in Egypt must never forget that the chlorosis of this climate is often the result of repeated and small hæmorrhages from the intestine caused by these parasites. Turpentine, as Griesinger points out, promises to be the best remedy both as a styptic and as a vermifuge," (*Brit. and For. Med.-Chir. Review*, l. c.)

7. The *Strongylus bronchialis* was first discovered by Treutler, in 1791, infesting the enlarged bronchial glands of an emaciated man. The parasite is cylindrical, slightly narrowed anteriorly, filiform, but somewhat compressed at the sides, semi-transparent posteriorly, and of a blackish-brown colour. It measures from half an inch to three-quarters of an inch in length.

8. The *Eustrongylus gigas* is fortunately rare in man, though common in a great variety of animals, such as weasels. It inhabits the kidney, destroying the substance of the organ, the walls of which become the seat of calcareous deposits.

9. The *Spiroptera hominis* is furnished with a spiral tail, having peculiar marginal appendages.

10. The *Filaria medinensis*, Guinea worm, or *Dracunculus*, lives amongst the connective tissue of man and of some animals. In this situation it is only known as a female, containing an enormous quantity of young *Filaria*, and resembles a long piece of uniformly thick white whip-cord. In this country few are familiar with its appearance, or with the lesions it produces; and we therefore look for our knowledge regarding the main points in the natural history of this parasite to be furnished to us by the

observer in Africa or Asia; and of whom we hope that they will fill up the gaps which still exist.

The Guinea worm is essentially a tropical parasite. It is endemic in the hot intertropical regions of Asia and Africa, extending from Egypt, about 23° or 24° North latitude, to Sumatra and adjacent islands, as far as 10° or 12° South. But it is only in some districts within these tropical limits that the parasite abounds. For example, it is endemic in Arabia Petrea, the borders of the Persian Gulf, and of the Caspian Sea, the banks of the Ganges, Upper Egypt, Abyssinia, and Guinea. Its occurrence in Guinea (although it has its common name from this place) is extremely capricious. In some districts every native who comes off to the ships seems to be affected by it; in other places in Guinea it is very rarely seen.

The *F. medinensis* is unknown in America, unless the person in whom it exists has been in the places where the *Dracunculus* is endemic. The only exception is the Island of Curaçuo. It is sometimes so extensively disseminated that it has been said to prevail after the manner of an epidemic.

Although this parasite rarely causes death, still it is often the cause of great distress and loss of strength to regiments quartered in those places where it is endemic.

In the *Statistical Sanitary and Medical Reports of the Army Medical Department* for 1860, the admissions for *Dracunculus* into the hospital may be shown as follows:—

I.—EUROPEANS.

Stations.	Average Strength.	Total Admissions.	Ratio per 1,000.
Home Stations,* . .	97,703	28	·3
Mauritius, . . .	1,886	17	9·0
Bengal, ...	42,371	51	1·2
Madras, . . .	10,696	19	1·7
Bombay, . . .	11,388	114	10·0

II.—BLACK TROOPS AND ASIATICS.

Stations.	Average Strength.	Total Admissions.	Ratio per 1,000.
Sierra Leone, . .	379	1	2·6
Gold Coast, . . .	313	77	246·0
South China, . .	2,611	73	26·0

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* It is of course to be inferred that these men had served abroad in countries where *Dracunculus* is endemic.

18-20 yrs — 14.8 days
40-45 31-620

It would be interesting to know how long each man was off duty or under treatment for the disease induced by this parasite. In India the average number of days which those affected with the worm remain in hospital increases progressively with advancing years. During the *first period* (18 and under 20 years of age) the average number of days under treatment—during which period each person was rendered ineffective—was 14·8; during the *second period* (20 and under 25 years) it was 16·188 days; during the *third period* (25 and under 30 years) it was 18·001 days; during the *fourth period* (30 and under 35 years) it was 22·718 days; during the *fifth period* (35 and under 40 years) it was 24·290 days; during the *sixth period* (40 and under 45 years) it was 31·620 days (EWART).

Dr. Leith, in the *Bombay Mortuary Reports*, records 133 deaths from *Dracunculus* in eight years (from 1848 to 1857). A fatal result generally takes place from hectic (LORIMER) and exhaustion, consequent on the copious discharges which sometimes follow the presence of the parasite, or from abscesses forming and bursting into the abdominal cavity (EWART). Death has followed from tetanus (Drs. Minas and M'Kenzie, *Trans. of Hydrabad Med. and Phil. Society*). Great destruction of tissues sometimes results from sloughing; and deep-seated inflammation may attend its existence, with the formation of abscesses and deep-seated sinuses. The death of one person is recorded by Dr. Minas at Sirsa, in whom the whole body and skin was a net-work of Guinea worms. As a rule, however, the patient is unconscious of the presence of the *Dracunculus* till it is matured and ready to make its exit.

The Number of Worms observed in any one individual is very various. In the majority of cases only one is present, or known to be making its exit at one time. But there are remarkable exceptions to this rule. Mr. Forbes mentions that most of those affected have had two worms extracted; but many have had four, five, and six; and when he wrote he was then treating a man in hospital in whom no less than fifteen were exposed to view, and many of these were extracted. Dr. A. Farre mentions that as many as *fifty* worms have been met with in one person. Such cases, however, are confessedly rare even in India, where *fifteen* worms is about the greatest number observed.

Seat or Locality of the Parasite.—The lower extremities are by far the most frequently affected—or rather, the parasite most frequently tends to make its exit there;—98·95 *per cent.* of the parasites do so.

Two cases are recorded by Lorimer which were remarkable in this respect, that one gave vent to seven and the other to thirteen parasites. In the case where *seven* parasites were extracted, there were *two* from the left foot, *three* from the left leg, *one* from the right leg, and *one* from the left forearm. In the case where thirteen parasites were extracted, *four* were taken from the left foot, *two* from the right foot, *two* from the left leg, *one* from the right leg, *one* from the right thigh, *three* from the right forearm.

Dr. Scott writes that he has known the *Dracunculus* make its appearance in the socket of the eye, in the mouth, in the cheeks, and below the tongue. Dubois records its exit from the nose, the ears, and the eyelids. Dr. Kennedy records cases in which the parasite made itself apparent in the back and muscles of the loins. One preparation exists in the Museum of the Army Medical Department, in which a great number were removed from beneath the scalp. Instances are recorded in which the worm has been found in the internal viscera. All such cases are regarded as extremely rare. It is of importance to notice, however, that both Dr. Scott and Dr. Van Someran agree in stating that the men who carry water in India, in leathern bags on their back, are infested by the *Dracunculus* on all that part of the skin that has often been wetted; while Drs. Chisholm and Scott state that the legs of persons who walk among grass (especially during the rainy season, and particularly gardeners and agriculturists, and those who are obliged to wet themselves frequently) are at all seasons liable to *Dracunculi.* Some animals are said to be affected by the parasite. Forbes says that horses and dogs are so affected, and relates that a "tatoo" (a small Indian horse) was exhibited at Dharwar, having a *Dracunculus* protruding from its right hind fetlock. The parasite was of the usual size, and made its appearance as a boil; and no difference could be perceived in any respect in it from the *Dracunculus* which infests man. Clot Bey remarks that dogs are also sufferers; but on this head information is greatly to be desired.

Voyages — Shoulder — to elbow & wrist
Middle arm to midforearm & back to inner condyle of h.
Thigh to foot
Scrotum to ancle jt

Always travels downwards as rule

Migratory Powers exhibited by the Guinea Worm before Extraction.—Dr. Smyttan relates the cases of two officers, in one of whom the *Dracunculus* could be felt, and traced with the fingers like a cord under the skin at the top of the shoulder. By and by it made its way to the elbow, where it was equally distinct; and in a few weeks it gradually worked its way to the wrist, whence it was extracted. In the other case the Guinea worm was observed under the skin inside the biceps, and about the middle of the upper arm. It then passed round the elbow joint and down to the middle of the forearm, then back to the region of the inner condyle of the humerus, whence it was extracted. It was three months engaged in this peregrination. Dr. Paton records similar cases (*Edin. Med. and Surg. Journal*, 1806, vol. ii., p. 151); and Dr. Morehead says of his men that they had felt the Guinea worm in the thigh in the first instance, and subsequently they had been ejected from the foot. He has distinctly noticed the corded feeling of the worm below the skin, and observed that it was entirely gone the next day he examined the part. Dr. L. W. Stewart, of the Madras Medical Service, relates a very distressing instance of this kind which happened to an officer who had already extracted a Guinea worm fifteen inches long from his scrotum. Ten days afterwards he experienced an unpleasant sensation in the posterior aspect of the left thigh. Day by day the sensation shifted lower down, till it reached the popliteal space. A few days later the sensation was experienced in the calf. Hitherto nothing was visible; but at the end of sixteen days from the first sensation in the thigh the convolutions of a Guinea worm could be distinctly traced at the outer side of the ankle-joint. Dr. Stewart now wished to cut down and extract the parasite, but the evening was too dark, and he delayed till the following morning. By the morning visit, however, the parasite had again fled, and had taken up a position in the deeper muscles of the foot. Not a trace of the worm could be recognized in the place which he had evacuated. Many abscesses now formed, and severe inflammation of the foot resulted, which confined the patient for three months before he was free of this wandering parasite. Dr. Ewart says he has seen the worm change its position from the upper part of the lateral aspect of the thorax to the groin in the course of twenty-four hours; but he has never seen the creature travel from below upwards (*Indian Annals*, vol. vi., p. 490, July, 1859).

Structure of the Dracunculus.—It is often a matter of extreme difficulty to extract the whole worm without breaking it, and on account of its remarkable elasticity (for it may be extended to twice its apparently natural length), good measurements of any large number of worms are not easily obtained (BUSK).

Of forty Indian specimens Ewart gives the average length at 25·25 inches, the shortest being ·12$\frac{3}{4}$ inches, the longest 40 inches. Clot Bey records their length at from 6 inches to 4 feet, in Egypt. Carter gives their dimensions in India at about 28 inches long, and $\frac{1}{9}$th of an inch in diameter. He has dissected five. Busk gives the dimensions at from 4 to 6 feet, and $\frac{1}{12}$th of an inch in diameter; and he has made out that it grows in the human areolar tissue at the rate of about an inch a week. H. C. Bastian, Esq., of University College, has recently read an account of the anatomy of this parasite at the Linnæan Society; and from the records of these excellent observers we have now a very complete account of the anatomy of the Guinea worm.

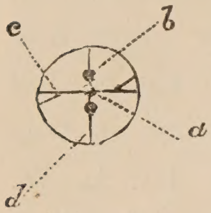

Fig. 20.*

The anterior end of the worm (fig. 20) may be recognized by a "punctum" in its centre, $\frac{1}{2000}$th of an inch in diameter, surrounded by rugæ in circles, the external of which was $\frac{1}{271}$ of an inch in diameter. Above and below are two papillæ opposite each other, with a transparent area in the centre of each. These are rather oval, $\frac{1}{475}$th of an inch in diameter, with a transparent area of $\frac{1}{1900}$th of an inch. Besides these, two lateral tubercles exist, much smaller, more indistinct, and farther from the punctum than the upper and lower papillæ. They are $\frac{1}{1900}$th of an inch in diameter.

It is difficult to obtain a good view of the head; for, as it is the first part to protrude through the skin, it is usually rubbed off or destroyed by the treatment adopted for extraction.

Great varieties in form are presented by the tail or posterior end of the worm (fig. 21). The remains of the attenuated extremity of the young *Filaria*, being more or less persistent in the form of a hook or spikelet, was believed at one time to be the penis of a male; and such specimens as showed such spikelets have been mistaken for male Guinea worms. All these forms, as Busk showed, have been found in specimens containing living young ones (proligerous). All are females that have yet been found, and no males are known to exist in the human body. The strength of the tissue of the *Dracunculus* is such that a loop of the parasite will suspend a weight of 11¾ ounces (SCOTT), and it is elastic to a remarkable degree. On opening the body, two longitudinal muscular bands are seen on the dorsal and two on the ventral aspect, running from end to end; while circular or transverse rugæ mark the whole extent of the worm; and these are approximated or apart as the worm is contracted or extended. The body of the worm (fig. 22) contains an alimentary canal, which commences at the "punctum," and terminates in the concavity of the tail end. It is of a yellow colour, nearly uniform in size throughout its extent, and in its course through the body winds several times round the genital tube (BASTIAN). No outlet has yet been detected. It is distinct from the tube containing the young (FORBES).

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* Diagram of the head or anterior end of the Guinea worm; showing (*a.*) Punctiform mouth $\frac{1}{2000}$th of an inch in diameter; (*b*) Upper large papillæ; (*c.*) One of small lateral papillæ; (*d.*) One of four crucial white lines meeting at the mouth, and occupying inter-muscular spaces, (H. C. BASTIAN, Esq.)

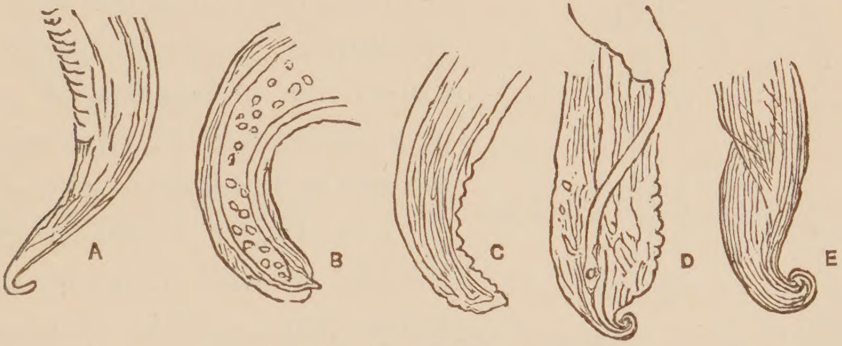

Fig. 21.*

The genital organs consist of a large uterine sac or tube, occupying nearly the whole length of the worm, and terminating abruptly at either extremity in a much smaller tube (probably ovarian), about three-quarters of an inch in length. No vagina or vulva can be discovered (BASTIAN).

The whole extent of this uterine sac or capsule is crowded with innumerable young, and, with the exception of a transparent half

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[*] Various forms of the caudal end of the Guinea worm.—(A, B, C.) after BUSK—all of them proligerous; (D.) after CARTER; (E.) after GREENHOW.

inch or so of the worm, the whole extent of the parent seems to be a *uterus*, a *matrix*, or a *proligerous capsule*, carrying a countless offspring, to which no parturient female of any animal can be compared for productiveness; and from the fact that no inlet has ever been discovered to the genital organs, and from various other circumstances, Mr. Bastian has endeavoured to show that this innumerable progeny has been produced by a process of *parthenogenesis* similar to that with which we are so familiar in the *Aphis*.

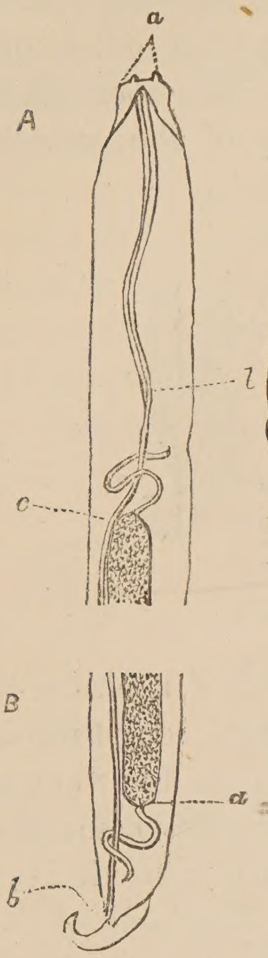

Fig. 22.*

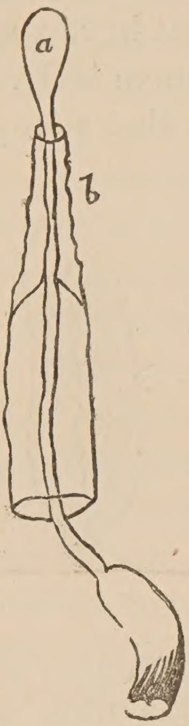

Fig. 23.†

If a living worm recently extracted be well lit up by an argand lamp, the hair-like filaments may be seen in motion with a good simple lens; and if a section be made across the parasite after it has been hardened in glue, the young may be demonstrated *in situ* (fig. 24).

When the animal is mature, and presenting its head through the skin, it protrudes the extremity of the proligerous capsule through one of the small papillæ or puncta, carrying forward a prolongation of something in the form of a loose corrugated sheath (fig. 23). It gradually assumes the form of a dilated vesicle filled with limpid fluid—the contents of the proligerous capsule—containing flocculent granular matter and young Guinea worms. Carter tells us that, if kept moist, the full-grown parent will live many hours; and in this state the young will live till the parent begins to decompose; and when the head end of the worm during its extraction may have been dried up for several days outside the wound, the remaining part with the young still remains alive. Mr. Busk says that the young survive after having undergone a considerable degree of drying up.

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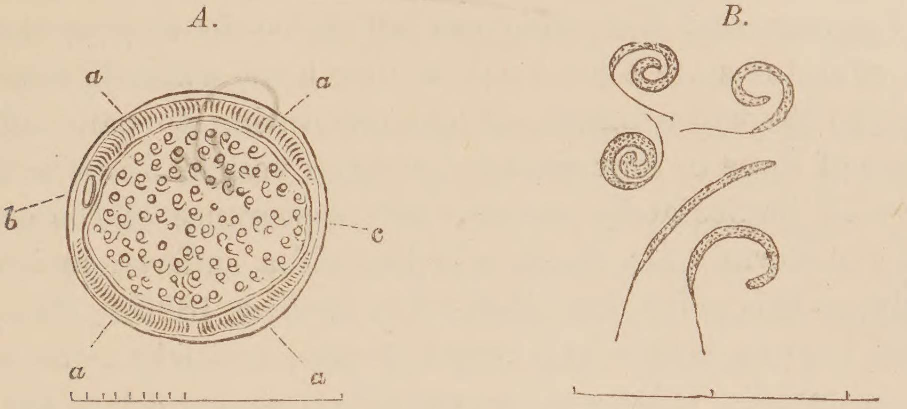
* *A.*—Anterior extremity of worm, slit open and magnified, showing, (*a.*) Upper and lower cephalic papillæ in profile; (*b.*) Junction of œsophagus with intestine, and constriction of peritoneal sheath; (*c.*) Anterior termination of uterus, with short ovarian tube. *B.*—Posterior extremity of worm, slit open and magnified in same way, showing its hook-like termination; and, (*a.*) Posterior termination of uterus with ovarian tube; (*b.*) Termination of intestine (Bastian).

† Anterior extremity. The ovisac (*a.*) is protruded, dilated, and contains young; (*b.*) A funnel-shaped sheath surrounding the protruding ovisac (Greenhow).



100ths of an inch × 5 diameters. 100ths of an inch × 50 diameters.

Fig. 24.*

Description of the Young.—They are exceedingly numerous, and constitute the bulk of the contents of the parent's body; but are less numerous towards the tail end. Each young one may be said to, tail consist of a body and a ~~tail~~, hair-like and finely pointed. The body constitutes $\frac{3}{5}$ths, and the tail $\frac{2}{5}$ths of the whole length. The anterior extremity has a blunt end, with a rounded oval orifice communicating with a cavity occupying about one-half of the whole length of the body, and terminating cœcally.

Symptoms and Life of the Guinea Worm.—As a parasite in the human body it may be studied during two periods of existence; but from the beginning to the end of its cycle of development its history embraces at least *three*, if not *four*, phases of existence or forms of life:—(1.) During the first period of its existence in the human body the Guinea worm parasite is latent, residing in the connective tissue, at variable depths from the surface. During this period it does not exert any irritating influence on the surrounding tissue, as has been shown by dissections (BUSK).

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* *A.*—Appearance of transverse section of adult Guinea worm, as seen throughout the greater part of its length.—(*a*, *a*, *a*, *a*.) Sections of the *four* longitudinal muscles; (*b*.) The intestine flattened, and lying along the edge of one of the longitudinal muscles; (*c*.) Walls of the uterine sac, often adherent to the parietes of the body. *B.*—Young of the Guinea worm more or less spirally curved (BASTIAN).

(2.) The second period of existence comprehends that of ripening or maturation of the worm and its progeny, when the worm makes itself felt, and begins its exit through the skin. This period is marked by characteristic symptoms. Drs. Scott, Forbes, Morehead, Lorimer, and Van Someran all agree in stating that the earlier symptoms are a pricking, itching heat, which is felt at the part where the worm exists, seldom amounting to pain till after the lapse of three or four weeks. A small vesicle forms over the part, which immediately precedes the appearance of the anterior end of the worm. Dr. Scott was himself a sufferer, and writes feelingly on this point (See *Med.-Chir. Review*, 1823). This itching may happen before any vesicle forms; and when the vesicle forms, it rapidly enlarges—so rapidly that in a few hours it attains the size of a good large filbert (Lorimer). If this vesicle is opened early, it is seen to contain a clear and limpid fluid (the fibrinous serum of irritation?); but if untouched for a day or two, its contents become turbid, and sometimes bloody, from the rupture of the proligerous sac, and the discharge of the young *Filaria* amongst the serum. These greatly add to the irritation, so much so, that when the cuticle is removed, an angry-looking ulcer is exposed, in the centre of which the parasite may be seen presenting itself, *with a thin transparent tendril about an inch in length hanging from its point.*

After the appearance of the vesicle or blister, it is sometimes weeks before the worm protrudes itself.

The contents of the blister, when turbid, are a discharge from the tube of the animal; as Wilkins, of 4th Light Dragoons, first surmised, and as shown afterwards by the independent observations of Forbes, who found that the best way to procure the young Guinea worm for microscopic examination was to lay open this vesicle before the delicate membrane of the proligerous capsule burst. After the escape of the serum from the vesicle, the delicate transparent membranous tube or *cul de sac* is sometimes protruded from the extremity of the worm; and if cold water is *gently* poured in a *constant stream* upon this protrusion, the dilatation and protrusion increase, till an innumerable quantity of young is ejected from the ruptured orifice of the dilated tube. Forbes says that he has often repeated this experiment; and in one instance the transparent tube was again retracted within the limb, after three emissions of young Guinea worms. On the following day the tube was found again protruding as before; and the same result (namely, emission of young) followed the gentle application of the stream of water. The animal will emit its young daily in this way for some time; and when it ceases to emit them, it is then time to begin the extraction of the parasite (FORBES).

The Period of the Year when Dracunculus is most Prevalent.—This seems to vary considerably in different parts of India, and the probable causes of these differences are of great interest in regard to the origin and spread of this parasitic affection.

At Madras and its vinicity Guinea worm annually appears with greater prevalence during the hot season (LORIMER), comprehending February, March, April, May, and June. At Dharwar and its vicinity the admissions to hospital for Guinea worm generally commence in April and May. At this time water is scarce, every tank is dried up, wells yield a scanty supply, and the natives are obliged to remain at the bottom of the wells by turns, till the required supply is obtained; and when the monsoon sets in (rainy season), the admissions gradually increase through June, July, August, and September. The increase of the disease amongst soldiers or residents seems to advance with length of residence, generally during the rainy season. In the Bombay and Matoongha districts the admissions to hospital begin in May or June (irrigation of fields by the natives being common at this time), but it chiefly prevails during the rainy months of June, July, August, and September, and is rare after October (SMYTTAN). Dubois, a missionary at Sattimungalum, says that its annual endemic prevalence in the Carnatic villages is in December, January, and February, during which time more than half the inhabitants are affected. Dr. Morehead's experience at Kirkee and vicinity gave March, April, May, June, and July as the months of gradual increase and prevalence; and September, October, November, December, and January as those of comparative exemption.

In the Bheel districts Guinea worm begins to increase in frequency in February; it is *four* times as frequent in March, and *six* times as common in April, as in February. It reaches the monthly maximum of prevalence in May. It prevails to a great extent in June, and continues to be common throughout the monsoon months of July and August. During September, October, November, December, and January it is least of all prevalent.

The half of the year comprising the hot and rainy season is, therefore, the period when *Dracunculus* abounds, abruptly commencing with the initiation of the former, and terminating more abruptly still with the exhaustion of the monsoon in September (Ewart).

All the records agree in assigning to this parasite—(1.) An annual periodic recurrence; (2.) Periods (annual) of progressive increase and subsidence; (3.) A probably fixed latent period of residence in the connective tissue—a period of incubation—of not less than twelve months (Lorimer, Mitchell); or of twelve to eighteen months (Busk).

The Guinea worm never makes itself manifest in the human body before the second season of residence in the places where it is endemic, a complete season being requisite to mature the worm.

There are some remarkable cases which fix the period of incubation of the Guinea worm in a very decided way. For example, in some excellent remarks on this subject by J. Mitchell, Esq., in the supplement to the *Madras Times*, of December 18, 1861, and January 13, 1862, it is related of a gentleman, well known to be extensively acquainted with natural history, that when he was travelling in the Northern Circars, the tents were pitched near a tank, of bad repute. He was accompanied by five friends, who, against his advice, bathed in the tank. Each of these five persons subsequently became affected with the Guinea worm. In the Indian annals many accurate accounts are given which fix the period of incubation at about twelve months.

Geological Features of Locality and Soil where the Dracunculus is Endemic.—Evidence of a circumstantial kind tends to connect the parasite with something geologically characteristic in the *soil*, *mud*, *moisture*, or *water* of the places where the parasite is endemic; yet information is still very imperfect on these points. Morehead believes that all the districts where *Dracunculus* prevails are composed of the secondary trap rock—*i. e.*, of igneous formation, as in the villages of the Deccan and Northern Concan, where the parasite is indigenous. In the country between the Western Ghauts and the sea-coast, where the parasite is rare, the soil is a conglomerate ironshot clay, of a red colour.

Chisholm's investigations on this point led him to the conclusion that the districts where Guinea worms abound (*i. e.*, in man) are of volcanic origin, with an argillaceous soil, holding much moisture, impregnated with salts or percolated by sea-water. Dr. Carter's evidence as to soil is, that the parasite abounds where the soil is a decomposing trap, of a clayey consistence, and of a yellow colour.

Every regiment which has occupied the lines of the 24th Regiment at Secunderabad, "near the large tank called the 'Hausen Saughur,'" has suffered from the *Dracunculus* (LORIMER). The cause of the disease exists *in or near* the lines at that place; and the soil is marshy which borders on the tank. The experience of the 19th, the 4th, 5th, 1st, and 35th Regiments of Native Infantry all fix the locality of the Guinea worm germs to be "*in or near these lines.*" For example, the 19th Regiment arrived at Vepery on the 20th May, 1838. It had been free from *Dracunculus* for five years before: twelve months after its arrival twenty-eight cases of Guinea worm appeared, and several cases amongst the followers and children. The 45th Regiment occupied the same lines previous to the arrival of the 19th Regiment; and the disease appeared amongst them at the same season of the year, and after twelve months' residence. The Guinea worm had not been amongst them for many years before. At Perampore (in the 1st Regiment, N. I.) it manifested itself, after twelve months' residence, in March, April, and May. For many years previously Guinea worm had been unknown in the Regiment. Those who suffer most in cantonments are those who use water of the filthiest kinds.

On the authority of Scott, Smyttan, Chisholm, and Duncan, Guinea worms are said to have been found in the earth or soil, and that they have been dug out of moist earth. There can be little doubt, however, but that the worms so found were specimens of the *Gordiaceæ*.

In some form or another, therefore, the Guinea worm has an existence in moist earth and mud; and it is probable that the hair-like worms found by gardeners in India coiled up together may be the young *filaria* of the Guinea worm in sexual congress; whose progeny, as *Zoösperms*, or as filiform female worms (like the Tank worm of Carter), make their way into the body. It is known that the *Gordius aquaticus*, when young, enters the bodies of large water beetles, and at a certain stage of life it leaves its abode in the beetle and goes into the water, where it becomes a variety of *Tank* worm. It appears that there are white and brown *Tank worms*—nay, that there are no fewer than seventeen species of minute *Filaria* (Carter, Mitchell); and some say that all *Tank worms* are white at first, but become black after a time in the water (Gunther). Observations are greatly wanted on these points. According to observations collected by Pallas and quoted by Vogel, it appears that even in Europe thread worms like the *G. aquaticus*, common in stagnant water and moist earth, can in certain cases infest the human subject (*De Infestis Viventibus intra Viventia*, p. 11).

The most obscure and incomprehensible parts of the history of this parasite are—(1.) The phase of its existence and that of its young after it leaves the body of man; and (2.) The future life of the young, and their sexual differentiation.

The parasite may be removed in several ways by surgical interference—either by cutting down upon it; or, after it begins to show itself, to commence winding it on a stick, gently pulling a portion of it out every day. But there is a natural termination to all diseases; and it is a fair subject of inquiry as to what becomes of the *Dracunculus* if left to itself, and its expulsion unaided by art. How would it be expelled, and what becomes of the progeny? Is it probable that they would ever be placed in circumstances where they could lead an independent existence, becoming sexual, and multiplying their kind?

In reply to these questions it is to be observed that there are undoubted examples of the *spontaneous evolution* or *expulsion* of the Guinea worm. Scott once observed about five inches of the worm to start suddenly out, firm, elastic, and spirally twisted like a cork-screw, showing evidence of resistance to a progressive force from behind. So firm was the parasite that it supported itself for a little time perpendicularly to the limb. It is only when the animal dies that great mischief happens to the part where the parasite is. Then and there it acts as a foreign body; but alive it does not cause disturbance (John Hunter *On the Blood*, 4to, 1794, p. 208). The part first protruded is the head; and its future progress, though slow and invisible, becomes in time very obvious (Scott).

As an example of its spontaneous evolution or expulsion, Dr. Forbes relates that on one occasion eight Sepoys were admitted with Guinea worm, and all of them had a characteristic vesicle on the ankle. These vesicles were opened on the fourth or fifth day. The loose skin was cut away with scissors, and a stream of cold water was poured daily on the part. Under these circumstances the young were daily ejected from the proligerous tube of the parent parasite, and continued to be so for fifteen to twenty days. After this time a watery fluid only was emitted, without any young, but sometimes containing particles of a white flaky appearance, which continued two or three days longer. The Guinea worm then became flaccid, and was discharged spontaneously, without pain or swelling. The only exception was in one case, where the worm was constricted by the pressure of a band of areolar tissue, which led to retention of the young, and sloughing.

Dr. Kennedy relates an anecdote which has an interesting bearing upon the spontaneous evolution and the probable future of the Guinea worm after expulsion. "In 1791, when marching up the Ghauts with a Sepoy battalion, an African stepped out of the ranks and requested permission to go to a rapid running stream of water near by, in order to relieve himself, after his own fashion, of a worm in his ankle. The man unbound a bandage from his foot, loosened the worm (of which a part was extracted) from the cloth round which it was secured, and plunged his naked foot into the current of the stream. The constant but gentle force of the running water was sufficient to stimulate the worm to come forth, and it was extracted almost immediately." Another custom has been recorded by Dr. Lorimer, which illustrates the spontaneous evolution, and points, at the same time, to the probable future of the Guinea worm. He says, "Many people belonging to the bazaars in the vicinity of the lines, affected with the parasite, came for the express purpose of extracting the worm to the same tank where the men of the regiment bathe. The people so infested swim about in the water with the worm hanging loose, drawing the limb quickly backwards and forwards through the water, and from side to side, till expulsion is effected." The natives do not believe that they get the parasite from bathing in the water.

In these and similar cases the parent, being carried away in the stream, finds a place to die, and so gives freedom to her immense brood of young. The water seems congenial to the parent Guinea worm, and sooner than anything else induces her to leave her position in the human body, and so to extricate herself, perhaps by stimulation of the muscular structures. This water method of extraction was also recommended by Dr. Helenus Scott, of Madras, (*Edin. Med. and Surg. Journal*, vol. xviii.)

Vitality of the Parasite in Water.—It has been stated that young *Dracunculi* die in four, five, or six days if placed in pure water from well or tank (and that is the case with many animals), simply for want of food. Water *not pure* is, no doubt, the proper element for them (MITCHELL). Those artificially kept in impalpable red clay, partially covered with water, and exposed to the sun, were found alive after fifteen, eighteen, and twenty-one days, burrowing into the fine soft and ochry mud.

Forbes experimented on two pups five or six months old. He poured down their throats water containing the young Guinea worm *Filariæ.* After three minutes the first pup became uneasy, sick, and vomited; the watery part of which was found to contain the animal still alive. Four hours after this the pup was killed, when abundance of *Filariæ* were seen in the mucus of the stomach and duodenum; but none showed signs of life. The other pup was killed twenty-four hours afterwards, but none were alive, although abundant in the mucus. Lorimer tried upon himself and others if the parasite could be propagated by inoculation of the young *Filariæ* emitted from the parent's orifice. Five besides himself were inoculated. He naively remarks that *he is sorry to say* they did not hatch in any, although in his own case he put them in their favourite place—namely, the *foot and ankle.*

Such experiments were not likely to succeed, from the delicate nature of the young *Filariæ*, and because they were introduced under unnatural circumstances. Inflammation and pus are inimical to the life of the worm. Besides, it is most probable that they enter the body in some other form. They seem to go through another stage of existence, and become sexual; for it is *only females*, and these *impregnated ones*, which are found in the body of man. The progeny of the sexual *Filariæ*—and the impregnated females only of that progeny—would therefore seem to be the *Dracunculus* of man.

Dr. Ewart, in his able paper on the vital statistics of the Meywar Bheel corps, writes as follows:—"I am inclined to believe that Guinea worm is propagated by a female and impregnated *Zoösperm*, and not directly from either the young of the full-grown female Guinea worm or from tank worms" (*Indian Annals*, vol. vi., July, 1859).

Examination of Water, Mud, and Tanks.—In the months of August and September, 1837, Dr. Forbes examined several of the tanks in the vicinity of Dharwar, and found the mud on their banks, and in half-dried beds, abundantly supplied with animalcules (*Filariæ*), some of them very much resembling those produced by the Guinea worm when infesting the human limb. Their vermicular motion in the water is exactly the same; their general appearance is the same; and they are active and equally numerous. The point of a penknife inserted into the mud will raise up abundance for examination. They are most numerous where the water assumes a variegated appearance, with a pellicle floating on its ochry surface; and the fine, soft, impalpable mud just above water-mark contains most, and the best time to find them is about three or four o'clock in the afternoon. Two kinds may generally be detected in the soft mud: one kind is seven or eight times the size of the Guinea worm young *Filariæ*, the other exactly resembles them.

The larger one may be the more mature form of the progeny after becoming sexual.

The smaller one may be the first generation born of that sexual progeny—whose females, being fecundated, enter the body of man in this young and minute condition.

Dr. Carter had medical charge of a school containing nearly 400 children. "One morning a case of Guinea worm in a child little more than four years old was reported to him. There having been only two cases of this disease in the school during the previous eight years, Dr. Carter, who had before noticed the resemblance of the aquatic *Filaria* of Bombay to the larva of the Guinea worm, was led to make inquiries, when he learned that the child was the son of the sergeant of the Industrial School situated about three miles off, and had been only a little more than three months in the school. Upon further inquiry he found that the sergeant's wife had then a Guinea worm in her ankle, and that twenty-one out of fifty boys had been affected with Guinea worm during the past year. Some boys had had as many as five extracted, and ten more were then suffering from the disease, all of whom had been in the school *more than a year*. None of those who had been less than twelve months in the school had been admitted to hospital on account of Guinea worm.

"The boys were living in an embanked enclosure that had been taken in from the shore, the fourth side of which was formed by a cliff of the mainland, on which resided the sergeant and his family. In this enclosure were two small tanks, ten feet square, sunk *in decomposing trap*, one being six feet, the other three feet deep; the first furnished drinking water, in the latter the boys bathed. The sergeant also obtained his bathing-water from these tanks, but the drinking-water from a well at some distance.

"These tanks contained *Confervæ;* and Dr. Carter states that every small piece as large as a pea contained twenty or thirty of the tank worms. He examined the *Confervæ* of the tanks at the Central Schools, where there had been no cases, or only two in eight years, and failed to find the worm after the closest scrutiny. Hence he argues, and with apparently good reason, *No Tank worm—No Guinea worm;* but that persons who bathe in water in which the former is found may expect to have the latter.

"Dr. Carter further states that the Industrial School is situated near an old artillery barrack, now in ruins and overgrown with weeds, which had to be abandoned in consequence of the havoc made among all ranks, officers as well as men, by this fearful parasite," (MITCHELL, l. c.)

The habit of the tank worm is to bury itself under any organic *debris* that may be in the water in which it is found; and if it be disturbed, it will immediately seek a hiding-place, nor rest until again covered. This implies that its proper habitat is the bottom of tanks, wells, or other reservoirs, among the decayed and decaying organic matter. It may be assumed that the water-carriers referred to by Dr. Morehead were Army Bheesties, who as such probably had access to good puckah wells (Dr. Morehead having found that Guinea worm was not more common among them than among other people), and as the tank worm, habitually resident in the mud at the bottom, would only be disturbed when the water became very low, and would get back again to its retreat if possible, the fact of water-carriers being as little affected with Guinea worm in the upper part of the body as other people does not carry so much weight as at first it would seem to do, and as it would in reality if the tank worm was in the habit of swimming at the surface like many other aquatic animals. It has not been said that the worm finds its way into the body by any of the natural cavities of the body, such as the alimentary canal. On the contrary, it is supposed that the water may be drunk with impunity, as known by experience, and from the experiments of Forbes already noticed.

The young *Filaria* can work its way into a proper receptacle by its pointed extremity, "which is a long cone, ending in a point so inconceivably fine that the point of a cambric needle is a large marline-spike in comparison with it." But notwithstanding its exceeding tenuity, it appears tolerably rigid, and as the proper receptacle referred to is one of the sudoripurus ducts, a ready-made /parous aperture exists for a distance quite long enough to contain so small a creature; and it is by no means inconceivable to one who has seen its active exertions, that it should be able thus to hide itself in a foot or leg kept for some time in the water. It is unnecessary, perhaps, to do more than allude to the well-known native custom of going into a tank to take water. In these tanks water-carriers may often be seen standing for five or ten minutes at a stretch chatting and washing themselves. They of course stir up the bottom mud, and, if the tank worm be there, and is the origin of the Guinea worm, they certainly afford it every opportunity to effect a lodgment—the instinct of the parasite directing the effort. One circumstance which makes this the probable mode of entry is, that natives are much more subject to attack than Europeans.

Thus the evidence is very strong which refers the entrance of the parasite to bathing or lying on moist places where the tank worms abound.

Greenhow states that the sepoys of the Maiwara battalion bathe and drink the water of a well sunk in the limestone rock, which generally contains about twenty-eight feet of water, clear and sweet; while the prisoners of the jail at Beaur use similar water from another well; but they never bathe, which the sepoys do every day. The result is, that *Dracunculus* is much more prevalent among the sepoys, compared with the prisoners, in the proportion of three to two. Again, amongst "Puchallies" the numbers affected are four times as great as among the men of the regiments. The former frequent the tanks more than the men of the regiments.

Generation and Propagation of the Guinea Worm.—The following periods may be recognized in its natural history:—(1.) It is probably got by bathing in tanks or places where the young and impregnated females abound. (2.) A period of maturation in the human body takes place. (3.) A time favourable for extraction comes, when the animal seems to seek delivery from its imprisonment, to fulfil a new law of its existence. The adult animals perish annually. It is necessary they should die, that the young may live; and, indeed, the Guinea worm of the human body is not adapted to live. It has no functional arrangements for life.

Men being exposed to the cause about the same time, the period for extraction will arrive about the same time in all, but with just sufficient variation (as to time) as to suggest the idea of contagion (Scott, *Med. and Surg. Journal*, vol. xvii., p. 99). But the idea of contagion or infection from one man to another (as Bruce, M'Grigor, and Paton wished to establish) is quite untenable. The evidence is all the other way.

In Paton's cases on board Her Majesty's ship "Cirencester," from 30th May, 1805, to 9th August of the same year, the origin of the disease is quite traceable to the preceding July and August, when the ship lay in Bombay harbour (*Med. and Surg. Journal*, 1806, vol. ii., p. 151).

Sir J. M'Grigor's cases in the 88th Regiment, and the absence of Guinea worm among the artillery on shipboard, related in his medical sketches, were not fully investigated. We have no account of the water supply previous to embarkation. Afterwards he wrote a paper, or rather an account of the sickness in the regiment from all diseases, in the *Edin. Med. Journal*, vol. i., p. 270, and from this it appears that the regiment had been quartered in the Fort of Bombay, which is partly surrounded by a wet ditch; and several months after leaving this place most of the cases of Guinea worm occurred. Bombay is well known to be extremely infested with Guinea worm.

Moseley is reported to have said that "there is as much foundation for believing *Dracunculus* to be contagious as that a thorn in the foot is contagious." As observed by Rudolphi, the parasite is known to occur in persons who have neither eaten nor drank in the countries where it is endemic, but who have exposed themselves to its moisture and its mud. The moisture contained in native canoes is sufficient to have carried to a ship off the coast the germs of the Guinea worm, which find their way into the seamen of the ship, who are in the habit of going into these canoes with bare feet.

Negative evidence, which would attempt to show that tank worm does not exist, cannot be received. Most of the examinations on which such negative evidence rests have been imperfect; having been made with instruments confessedly imperfect, and perhaps by men not accustomed to use the instrument. I speak only of written and published statements, and on the authority of Dr. Lorimer.

Problems for Solution.—Forty years ago Dr. Scott suggested that a patient and careful investigation of soils and waters ought to be made wherever *Dracunculus* is known to be endemic, and especially the soil round brackish wells and the beds of tanks. Morehead, in 1833, recommended that the following points be attended to, namely:—(1.) Geological structure of the ground and nature of the site generally; (2.) Nature of soil, wells, and well-water; (3.) Nature of rocks through which wells are sunk; (4.) Abundance or scarcity of water; (5.) Seasons of increase or decrease of the disease; (6.) Opinions of natives.

The occurrence of Guinea worm is sometimes defined by a distance of a few miles. So it is with many algæ and minute water animals and plants as to habitat. *

2. *Filaria lentis.*—Length, $\frac{3}{10}$ths to $\frac{6}{10}$ths; width, $\frac{1}{500}$th of an

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* My friend, H. C. Bastian, Esq., M.B., of the London University, London, has recently furnished a most interesting account of the anatomy of the Guinea worm to the Linnæan Society, and has been kind enough to furnish me with drawings of his observations; and he writes to me as follows:—"Since I saw you last I have discovered several species of Carter's 'tank worms' in soft mud, &c. (at Falmouth); that is, small *Nematoids*, agreeing in almost every respect with those found by him in Bombay. The more I see of these, the more thoroughly am I convinced of the undoubted relationship existing between them and the Guinea worm, coinciding as they do in their anatomy even to minute details, and in many respects where there is a salient distinction between the anatomy of the *Dracunculus* and that of the *Ascarides.* One which I sketched to-day had an exsertile rigid, sharp-pointed œsophagus.

"The great difficulty in the theory is to account for the fact of the localization of the disease, whilst these animals are probably so widely spread; and I suppose it is one particular species which is limited in its diffusion; but I suspect that many of those others will hereafter be discovered as parasites in animals or vegetables. The *Vibrio tritico* I have examined, and find it to be a worm essentially similar; and Dr. Cobbold tells me that he has found a long thread-like worm in the subcutaneous tissue of the back of a water-bird. The whole question wants working out."

inch. The body is thick posteriorly, filiform, and ending in a pointed tail, transparent, and partly coiled up in a spiral form. The *alimentary canal* is surrounded by the folds of the oviduct.

This *Filaria* (*F. lentis*) is very imperfectly known, and the female only has been seen. It was detected by Nordmann in the *liquor Morgagni* of the capsule of a crystalline lens of a man whose lens had been extracted for cataract by the Baron Von Gräfe. In this instance the capsule of the lens had been extracted entire; and upon a careful examination half an hour after extraction, there were observed in the fluid two minute and delicate *Filariæ* coiled up in the form of a ring. One of them presented a rupture in the middle of its body (probably made by the extracting needle), from which rupture the intestinal canal was protruding. The other was entire, and measured about $\frac{6}{100}$ths of an inch in length. It presented a simple mouth, without any apparent papillæ, such as are seen to characterize the large *Filaria* which infests the eye of the horse; and through the transparent integument could be seen a straight intestinal canal, surrounded by convolutions of the oviducts, and terminating at an incurved anal extremity (OWEN, p. 64).

A *Filaria oculi* vel *lachrymalis* has been described as not uncommon among the negroes on the Angola coast, where it is called *loa;* also at Guadaloupe, Cayenne, and Martinique. Its length is $1\frac{4}{10}$ths to $1\frac{9}{10}$ths of a line. It is a filiform, slender worm, pointed at one end, obtuse at the other, tolerably firm, and of a white-yellow colour.

This parasite has been considered a *Strongylus* by some, by others a young Guinea worm, and by others as an *Oxyuris vermicularis.*

Treatment of those Infested by the Round Worms.—The habitat of the *Ascarides* being for the most part a collection of mucus, the means used for their expulsion is generally some purgative medicine, as two grains of *calomel* and ten grains of *jalap,* or as many of *scammony,* given two or three times a week. The purgative ought in no instance to be given oftener; for if the purging be continued, the intestine is weakened, and more mucus secreted; so that the secretion which harbours them is increased. In weakly children small doses of Epsom salts will ultimately effect the same object, and with less distress to the patient. Many persons place great confidence in *calomel* as a medicine

℞ Santonine gr j – vj Jenner for Ascaris
Sacchari Lactis gr xv

Jenner
Tinct. Ferri - Perchlor for Oxyuris

capable of destroying them; but it does not appear to act beneficially except as a purgative, and consequently it is an auxiliary, and not by any means the most valuable part of the treatment.

℞/

The *Oxyurides* or small vermicular *Ascaris*, being situated so near the rectum, enemata have at all times been much used in the treatment of these cases; and injections of oil have been much commended, especially of castor oil, olive oil, or sweet oil. But these animals will live from thirty-six to forty-eight hours in castor oil. Indeed, very little benefit has been derived from any such local treatment. Warm water injections tranquillize the intestine, and give more temporary relief than anything else. The *Oxyurides* are killed by cold; but it may not always be safe to throw a cold injection into the colon of a child. But if the child is otherwise a vigorous child, small injections of very cold water may be cautiously administered, with a few drops of *ether* or of *alcohol;* and injections of the following bitter substances have been found very useful in the treatment of the *Ascaris vermicularis:*—Three or four ounces of a strong *infusion of quassia* repeated three or four times, or a similar quantity of *lime-water*, have been found of service. At the same time it is also well to administer internally some bitter medicines;—for example, half an ounce (or any dose suitable to the age and strength of the child) of *compound decoction of aloes*, taken in the morning fasting, once or twice a week; and three ounces (or other suitable dose) of infusion of *quassia* may be taken every morning that the aloes is not taken.

ʒss Child

NaCl ℥j
H_2O Oj
for Enem

Chloride of sodium, to the extent of an ounce in a pint of *quassia infusion*, has also been found a useful injection; so also has an enema composed of *aloes*, *carbonate of potash*, and *mucilage of starch*. But whatever local remedies are used, it is necessary to attend to the general health, which usually is at fault. The digestion is generally slow and imperfect, the secretions from the mucous membrane of the alimentary canal being abnormal. For this condition, small doses of the extract of *nux vomica*, with *sulphate of iron*, in extract of *gentian* or *aloes*, or in rhubarb or colocynth pill mass, taken twice a day, will be found of great service. Santonine may be of service in some cases.

NB

From what has been already written, it will be seen how important it is, in the treatment of all these diseases, to take every means of utterly destroying, by burning or by chemical agents, all debris or excreta which may be passed by patients suffering from these parasites, and also how necessary it is to look well to the purity of all water supply used either for the purposes of food, drinking, or bathing, and to the quality of pork or bacon, in connection with the *trichina spiralis.*

ACCIDENTAL PARASITES.

Of this provisionally named class, several forms of which have been named, the occurrence of "PENTASTOMA CONSTRICTUM" in the human body as a cause of painful disease and death may be given as an example.

The Author had two portions of lung and three portions of liver, each containing an unusual parasite, sent to him from Jamaica, in August, 1865, for the Museum of the Army Medical Department at Netley. Staff Assistant-Surgeon Edward Barrett Kearney, Esq., is the donor of the specimens; and from his history of the patient's fatal illness, the following account has been drawn up:—

On the 11th of January, 1865, private Isaac Newton was admitted into the hospital of the 5th West India Regiment, at Up Park Camp, Jamaica, for an attack of *tonsillitis.* He was an African, enlisted about eight months previously from the slave depöt at Rupert's Valley, St. Helena, where all slaves captured in slave-ships are kept until disposed of. He appeared to be about twenty-one years of age, and of a thin spare habit of body.

On admission the tonsils were inflamed and enlarged, but not ulcerated; and there were aphthous ulcers about the tongue. He suffered from headache and pain across the back.

On the morning of the 14th he complained of great pain in the abdomen, which became tympanitic. His tongue was clean, but vividly red at the edges and tip, and it felt dry to the touch. The skin was very hot and dry and harsh, and his pulse 100. The pulse continued to increase in quickness; sordes soon began to appear about the mouth and teeth, and the tongue became furred and cracked. Large moist crepitation was heard over the whole surface of both lungs. He became low, and disinclined to be spoken to, and by six o'clock in the evening his mind appeared to be confused. He passed his urine and his stools involuntarily in bed.

On the 15th there was no improvement in his condition, and at ten o'clock at night he appeared to be in much the same state as before, and the bowels were confined.

On the 16th he appeared livelier in the morning, the skin cooler, but still dry. He was thirsty, and sordes were still about the lips and teeth. The conjunctivæ of both eyes were stained of a vivid yellow colour.

About nine in the evening he became suddenly worse. His pulse became very weak and almost indistinct, the skin cold, the countenance sunken, and covered with a copious perspiration. He appeared to be sinking, and he died at half-past ten that night.

Post-mortem Examination Fourteen Hours after Death.—The general appearance of the body was that of emaciation, with yellowness of the conjunctiva.

Thorax.—The subcutaneous areolar tissue over the chest and abdomen was of a deep yellow colour. The *pericardium* contained about four ounces of deep amber-coloured fluid.

The *Heart* was large and pale, but its substance was otherwise normal, and its valves healthy. The *Lungs* were both highly congested; and when cut into, a bloody frothy fluid exuded in quantity. The substance of both was very friable and yellowish in colour. "On the anterior surface of the *right lung and near the edge of its lower lobe, one or two yellow specks appeared. They were about the size of a spangle, and when cut into, worms were seen regularly encysted in its substance.*" On the posterior surface of both lungs there were numerous adhesions of long standing.

Abdomen.—The *Liver* was very large. extending into the left hypochondrium. "*Its surface was dotted over, both posteriorly and anteriorly, with about twenty or thirty yellow specks similar to those seen in the lung.*" The hepatic substance appeared paler and rather more soft than natural.

Stomach.—It was distended with air and fluid, containing about a pint and a half of a dark-green coloured fluid. The mucous membrane was congested in patches, in the stomach, and along the whole tract of the intestines. There was no ulceration, and no appearance of *Tæniæ*, either continuous or in proglottides, could be discovered. Other *organs were healthy.*

Description of the Parasite and the Lesions it produced.—Fig. 25 represents a small portion of the lung, with the little worm seen at *a* curled up in its cyst. The pleura has been removed, so as to expose the "rings," "markings," or "constrictions," which are characteristic of the body of this parasite. The pleura was opaque, and considerably thickened, probably from the irritation of the parasite.

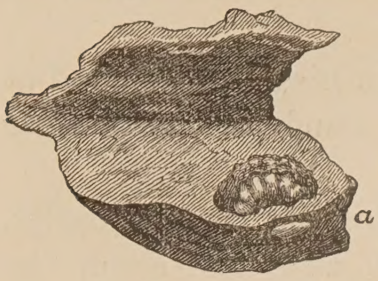

Fig. 25.

The appearance of the parasite on the surface of the liver was exactly similar to that in the lung, and therefore it is unnecessary to give another drawing; and wherever the serous covering of the organ was sufficiently transparent, the constrictions of the parasite could be seen distinctly shining through.

Fig. 26 represents two specimens of the parasite removed from their cysts. They are of the natural size, and one of them, *a*, is much shorter than the other, the constrictions being closer together: *a* measures five lines in length, *b* measures about eight lines. In diameter they are about one line. About 20 to 23 rings or constrictions can be counted on the elongated body, at tolerably regular intervals, and somewhat spirally arranged.

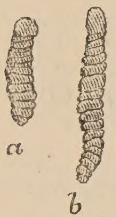

Fig. 26.

Fig. 27 represents the two specimens of the parasite slightly magnified (about three diameters): *a* is the shorter; *b* and *c* are the posterior and anterior aspects of the longer of the two worms. The head end appears compressed, so as to be flat and square-shaped at the end. It is seen to be marked with *five* spots on the anterior aspect, as shown at *c*. The posterior aspect of the flattened head, as shown at *b*, is comparatively smooth. The elongated body is rounded, and the caudal end terminates in a blunt-pointed cone. The constrictions appear like folds of the outer covering of the worm, each fold overlapping the one which follows, from the head to the tail. The body of the parasite is rounded, and not flat, as the tape-worms or cysticerci.

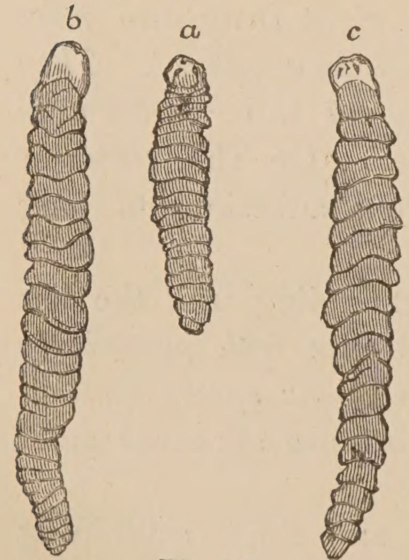

Fig. 27.

Fig. 28 represents the anterior aspect of the flattened head end (*cephalothorax*) of the parasite. It is so highly magnified as to show the nature of the *five* spots or marks shown in fig. 27.

The dotted lines from *a* and *b* point to two pairs of hooks or claws—one pair on each side of a pit or mouth, *c*. The points of the claws indicated by *a* are seen nearly in profile; those at *b* are directed more towards the observer. These claws appear to be implanted in socket-like hollows or depressions, surrounded by much loose integument. These socket-like hollows appear to be elevated on the summit of the mass of tissue which lies underneath the folds of integument surrounding the base of the hooks. These parts are regarded as the feet of the parasite, and the hooks are the foot claws.

The pit or mouth (indicated by the dotted line to *c*) is of an oval shape, the long axis of the oval lying in the direction of the length of the worm. The lip or outer margin of the pit is marked by a well-defined thin line. There are no spines nor hooks on the integument of the elongated body.

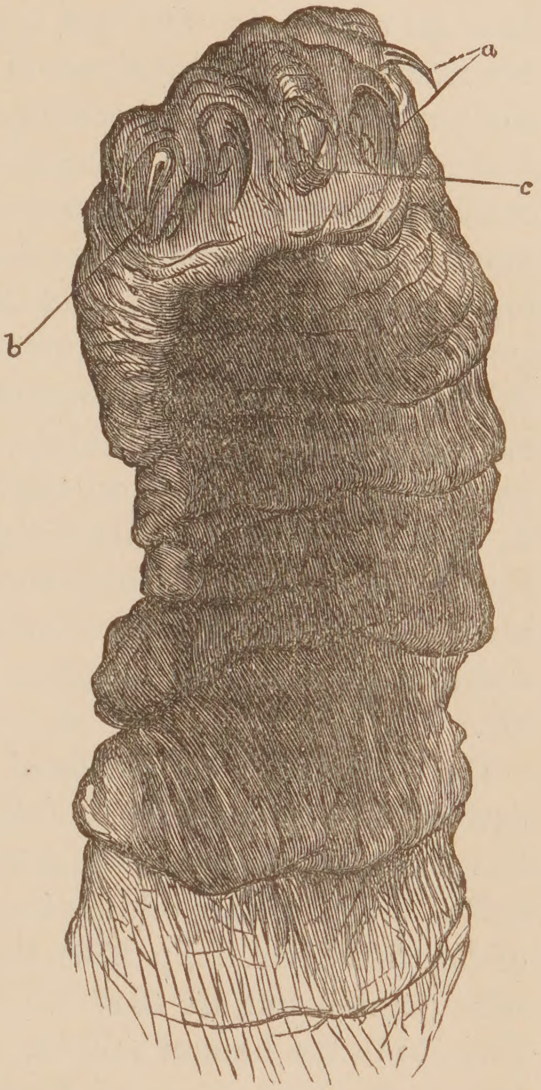

Fig. 28.

From the description and the drawings here given it will be seen that the parasite corresponds in its specific characters with the larval condition of the "*Pentastoma constrictum.*" It belongs to the family *acanthotheca* of Diesing, and has no structural connection with the true helminth parasites found in the bodies of man and other animals.

The parasite now described, when compared with the descriptions of *pentastomata* given by Frerichs, Cobbold, and other observers, demonstrates clearly that at least *two species* of *pentastomata* infest the human body; the *Pentastoma constrictum* being by far the larger, the more dangerous, and fortunately the more rare, of the two species. It is also still more satisfactory to know that, as a human parasite, neither of the two species has ever been detected in this country; and according to the researches of Dr. Cobbold, it is only in the encysted or larval conditions that the *pentastomata* are met with in the human body. As an embryo it becomes encysted. The cyst is composed of condensed connective tissue, and is lined by layers of loose flakes, which are evidently the remains of repeated castings of the skin of the parasite; and during the intervals of these successive moultings the worm makes considerable growth, so as to reach the size in which it is finally found. In this pupa or larval condition it occurs in the solid organs of the abdominal and thoracic cavities of man in certain geographical districts in Europe, Egypt, and the West Coast of Africa; and much more frequently in various herbiverous animals, such as the sheep, deer, antelope, peccary, porcupine, guinea-pig, hare, rat, and domestic cat (COBBOLD). In all these animals, and in man, the larvæ usually occupy cysts immediately underneath the serous covering of the liver and the lungs; and Dr. Cobbold mentions that he has occasionally found the *Pentastoma denticulatum* free in the cavities of the abdomen and pleura of animals.

Our knowledge of the natural history of these parasites is mainly derived from descriptions of the *Pentastoma denticulatum*, the larval or sexually immature condition of the *Pentastoma tœnoides* of Rudolphi. We are told by Frerichs (*Clinical Treatise on Diseases of the Liver*, vol. ii., p. 276) that Pruner was the first observer who pointed out, in 1847, the existence of the *pentastoma* as a parasite in the human subject. On two occasions he found *pentastomata* in the liver of Negroes at Cairo. He does not seem, however, to have determined accurately the nature of the parasite he observed; and he also subsequently found two specimens of the worm preserved in the Pathological Museum at Bologna, which had been removed from the human liver (COBBOLD). Bilharz has since repeatedly detected in the livers of Negroes at Cairo the parasite discovered by Pruner in 1847. Bilharz and Von Siebold made this parasite the subject of careful study; and they recognized in it a variety of *pentastoma* quite different from that which prevailed in some parts of Germany. They gave this new variety the name of *Pentastoma constrictum*—the parasite which has proved fatal in the case whose history Dr. Kearney has sent to me from Jamaica. It is the form of *pentastoma* endemic in

Egypt, and hitherto it is has only been found in the African Negro. It differs from the *Pentastoma denticulatum* (the larval form of the *Pentastoma tænoides*), "in not being furnished with any integumentary armature of spines, and in its being a much larger worm" (COBBOLD, p. 402). The *Pentastoma constrictum* seems to be from eight to twelve times larger than the *Pentastoma denticulatum*, and therefore is all the more dangerous from its actual size (nearly an inch long); and when it occurs in great numbers, as in the present instance, it cannot fail to prove an extremely irritant "foreign body," when it escapes into a serous cavity like the pleura or peritoneum—a mode in which it seems to cause death. The latter parasite (*P. denticulatum*) has been fully described by Frerichs, and figured by him in his *Atlas*, plate xi., fig. 9, as endemic in Germany in the human liver—in which organ it is considered to be far more common than the echinococcus.* Frerichs, however, regards the *pentastoma* endemic in Germany as devoid of clinical importance, because it does not give rise to any functional derangement. Not so, however, is such the innocent history of the *Pentastoma constrictum* as it affects the Negro; and after the history of the case now given, the clinical importance of this parasite cannot be disregarded.

As to the mode in which it tends to cause death, the evidence in this case, from symptoms and *post-mortem* examination, seems to point to *pneumonia* and sudden collapse from *peritonitis*. The Author is able also to verify this point in the pathology of this parasitic disease still more clearly from a preparation which has been in the Museum of the Army Medical Department since 1854, but the nature of which he could not understand till the history of the case now published was so thoughtfully furnished by Dr.

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* "In Germany," says Frerichs, "the *pentastoma* was first found in the human liver by Zenker in 1854: it occurs, however, not only in this gland, but also in the kidneys, and in the submucous tissue of the small intestine (WAGNER). The parasite is by no means rare with us. Zenker, at Dresden, succeeded in finding it 9 times in 168 autopsies (or, according to Kuchenmeister, 30 times in 200 autopsies). Heschl, in Vienna, met with it 5 times out of 20 autopsies; Wagner, at Leipsic, once in 10. According to Virchow, it is more common in Berlin than in Central Germany. During six months at Breslau, I (Frerichs) met with it in 5 out of 47 dead bodies. As a rule there is only one present; in rare cases there are only two or three. It presents the form of a somewhat prominent nodule, from 1 to 1½ lines in length, which is formed by a firm, fibrous capsule, easily detached from the surrounding parts. The animal lies coiled up in the interior of this capsule" (*On Diseases of the Liver*, vol. ii., p. 276).

Kearney, together with the specimens of the parasite *in situ* which he sent.

The preparation in the Museum, which has hitherto been a puzzle to all who have examined it, consists of four pieces of liver (fig. 29, *a*, *b*, *c*, *d*), and which appears in the Catalogue with the following description:—

"Portions of liver, containing numerous small cysts (evidently some jointed entozoön), taken from Private George Sutton, 1st West India Regiment, who died at Bathurst, Gambia; and for the history of the case reference is made to the annual report of sick and wounded from that station, dated March, 1854."

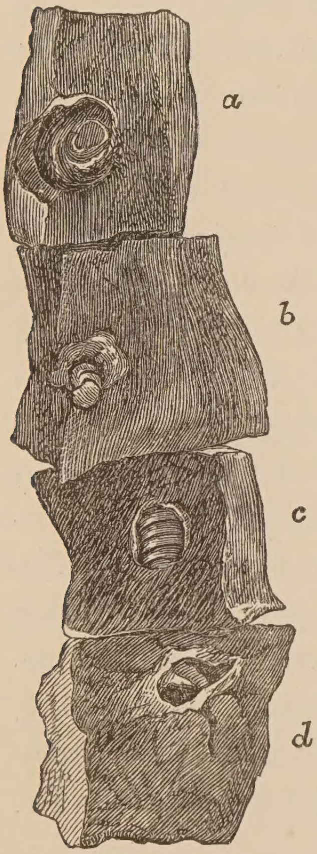

Fig. 29.

The Author is now able to identify this preparation as an example of lesions produced by the *Pentastoma constrictum.* At *a*, in the cyst where the larva has been, there is contained the debris of integumentary exuviæ; at *b* the head end of the parasite is seen peering out of an ulcerated opening in the serous covering of the liver. The edge of the opening is rounded and indurated, as if a good deal of local irritation had been maintained at the part previous to penetration of the serous covering. At *c* the ring-like constrictions of the parasite are seen shining through a very thin portion of serous membrane; and the portion of liver at *d* represents an empty cavity —whence one of these larvæ has passed out, probably into the peritoneum. The cicatricial-like contraction and puckering of tissue in the vicinity shows that considerable irritation has existed previous to the exit of the parasite.

We have no information as to how the *Pentastoma constrictum* finds its way into the human body, as an embryo and subsequent larva. Although in this instance the Negro was stationed in Jamaica, it is most probable that he had the germs of these parasites within him when he left his native shores in some part of Africa; and that this parasite is neither endemic in St. Helena nor in Jamaica. Reasoning from what is known regarding the propagation and development of the *Pentastoma denticulatum,* it is probable that the ova with the contained embryos are introduced into the human stomach along with uncooked vegetable food (fruits or salads), in regions where the mature animals are endemic. From the stomach the embryos, escaping from the ova, bore their way, and find a resting-place in the liver or other solid viscus, exactly like the embryo of the tænia. In solid organs (like the lungs and liver) they become encysted, and undergo the pupal transformations so well described by Leuckart and Cobbold in the case of the *pentastoma* endemic in Germany.

The drawings which illustrate this paper were made by Staff-Assistant Surgeon Dr. Humphrey C. Gillespie, from the preparations which are now in the Pathological Museum of the Army Medical Department at Netley.

LARVA OR GRUB THE EXCITING CAUSE OF BULAMA BOIL.

My friend Dr. Albert A. Gore, Staff Assistant-Surgeon on the West Coast of Africa, has kindly favoured me with the following account of this parasite and the disease which it induces :—

"This small larva or grub is of a white colour, a line or two in length, and is the exciting cause of a boil occasionally seen in the Island of Bulama and its neighbourhood (fig. 30). When magnified under a low power (fig. 31), it appears to be divided into a series of joints, and covered with minute bulbous hairs. On the anterior division are placed four or five red spots (*b*), and from either side project two hollow suction tubes (*a*, *a*). The posterior extremity seems to be terminated by a blunt hook. In applying a higher power the bulbous hairs turn out to be a number of beautiful black hooklets (fig. 32), which have a very pretty appearance on the white surface. A faint outline of a central cavity can be discerned. The hooklets are directed anteriorly.

Fig. 30.

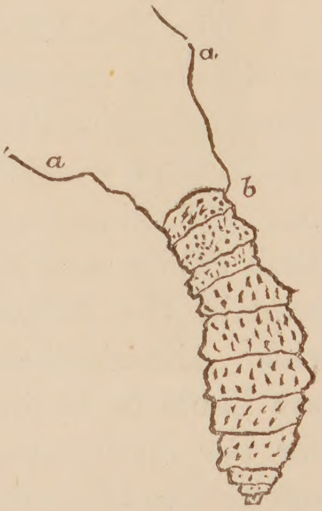

Fig. 31.†

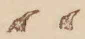

Fig. 32.‡

"**Symptoms, Treatment, &c.**—Attention is first attracted to the part by feeling an extreme itchy sensation. On examination, a small red pimple is seen. After awhile a small serous discharge oozes from its centre, which sometimes seems to pulsate. If allowed to progress, it becomes a regular inflamed boil, very painful, and often causing an erysipelatous blush, with inflammation in the neighbouring lymphatics, and tenderness of the glands to which they run. On the evacuation of the small abscess in the boil these symptoms gradually disappear, but a persistent red mark remains at the original seat of the disease. The treatment consists in poulticing until the little animal appears, when it can be withdrawn. If allowed to suppurate, it must be treated in the usual way of a boil under similar circumstances. The natives put in a mixture of salt and palm oil, which takes out the little grub.

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* Natural size of larva or grub, the exciting cause of Bulama Boil.

† The same grub magnified by a low power.—(*a*, *a*.) Hollow suction tubes ; (*b*.) Fine red spots. The other dots on the body are hooklets.

‡ Two of the hooklets highly magnified. These drawings were furnished by Dr. Gore.

"**Etiology and Pathology.**—This little worm cannot be the *chigoe* or *Pulex penetrans* of the West Indies, although it may result from the ova deposited by some similar aphanipterous insect. The *chigoe* chiefly attacks the toes or intervals between them, and causes a series of painful ulcers. It is also of a black colour. This small grub is white, causes a boil or two in any portion of the body, most commonly in the thigh, arm, or abdomen; it is sporadic, although endemic. They have one symptom in common—viz., the extreme itchiness. But this is complained of in nearly every case of disease resulting from insect or other living organisms."

SECTION II.—EPIZOA—*Animals living upon the Skin and Hair; and the Pathology of the Lesions with which they are associated.*

The animals which are associated with diseases upon the skin are of three kinds:—

1. The first kind belong to the family of "lice" (*Pediculidæ*), of the class *Insecta*, amongst the *annulose* or *articulated* animals. They belong to the order *Anoplura*, all of which are parasites and destitute of wings. They undergo no regular metamorphosis, as most other insects do; but in their growth to maturity they shed their skin a certain number of times, which may to some extent explain the irritation and forms of lesions to which they give rise. Almost all animals—man, quadrupeds, birds, and reptiles—are liable to be infested with these parasites; and were it not for our instinctive feelings of disgust with regard to them, as opposed to our notions of cleanliness and propriety, the study of their forms and habits is of considerable interest to the pathologist. Upwards of 500 species of lice have been described—universally diffused over the animal kingdom in different climates of the world. Their superabundance upon the persons of the human race are associated with some severe lesions of the skin; and authentic cases are related of death from lousiness.

2. The second kind of animals associated with diseases of the skin belong to the family of "mites" or "ticks" (*Acaridæ*), of the

class *Arachnida* or spiders, amongst the *annulose* or *articulated* animals. Some of these are free, others are parasitic, and vary somewhat in their structure accordingly. Those which live a parasitic life have the mouth in the form of a sucker. Such are the "ticks," which fasten upon dogs, cows, sheep, horses, and other animals. They bury their suckers so deep in the skin that it is impossible to detach them without tearing the skin to which they fix themselves; and they multiply so rapidly that oxen and horses attacked by them have been known to die of mere exhaustion. The harvest ticks (*Leptidæ*), one species of which, the *Leptus autumnalis*, well known as the harvest bug, is common in Autumn in grass and herbage, from which it gets on the body of man, and, though exceedingly small, produces extreme irritation of the skin. One only of these parasitic *Acari* has been found to live entirely in the skin of man—the *Sarcoptes galli* vel *Acarus scabiei*—producing the disease called the itch.

3. A third form of animal is found inhabiting the sabaceous sacs and hair follicles of the human skin—namely, the *Demodox folliculorum* (fig. 33). By some naturalists this parasite is referred to the *Acaridæ*, but by recent investigations it is considered to be more nearly related to the *Rotifera*, its parasitic habits causing it to resemble some of the numerous forms of the *Crustacea*. It is not known to cause disease.

The parasitic lesions and diseases with which these *epizoa* are associated may be described as follows:—

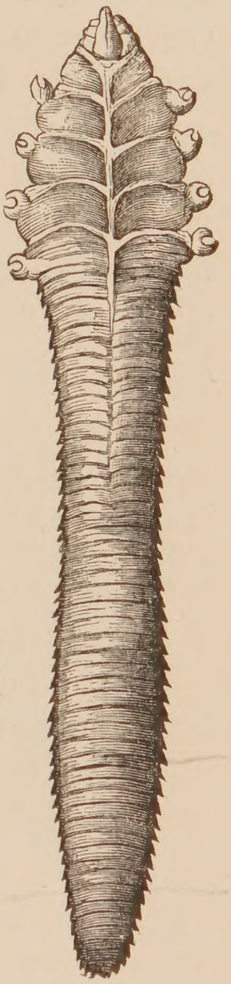

Fig. 33.*

LOUSINESS—*Phthiriasis.*

Definition.—*A morbid state in which lice develop themselves to such an extent that a* pruriginous *eruption is produced* (Prurigo pedicularis). *The skins of persons liable to constitutional skin diseases in which watery or secreting eruptions (such as* eczema*) prevail, are those most favourable for the development of lice.*

Pathology.—Five forms of lice infest the skin of man. One variety is met with on the hair of the head—the *Pediculus capitis;* a second variety infests the other hairy parts of the body, but especially the pubis; and hence its name—*Pediculus pubis;* the third form lives on the general trunk of the body—the *Pediculus corporis;* a fourth is the *Pediculus palpebrarum;* and a fifth the *Pediculus tabescentium.*

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* *Demodox folliculorum* (after Dr. Anderson).

The first four species, although they live in close proximity to one another, yet strictly limit themselves to the regions mentioned. In a clinical point of view the *P. corporis* is the most important.

1. *The Body Louse* (fig. 34) is of a whitish colour, and varies from half a line to two lines in length; the body elongated and the abdominal portion broad, its margins lobulated and covered with little hairs. The thoracic portion is very narrow, and carries three legs on each side. The legs are hairy, jointed, and terminate in claws. The insect secretes itself amongst the folds of the clothing, and causes extreme itchiness of the skin where it comes to feed. Between the irritation of the insect, the *debris* of its exuviæ, and the scratching of the skin by the patient, *papulæ* arise, the summits of which being torn off, give rise to a *pruriginous eruption,* which may even become pustular. This eruption is met with most frequently on the neck, back, and shoulders, and round the waist—the parts most tightly embraced by the clothing; and where the clothes are most frequently gathered into folds, between which the lice are imbedded, and where they deposit their eggs, or egg capsules, which are crystalline, shining, yellowish, opaque bodies. The lice seem to multiply fastest where eruptions such as *eczema* prevail. A case is reported by Mr. Bryant as having occurred in Guy's Hospital, in which the whole of the body was literally covered with lice. The patient had been a governess, about thirty years of age; and the irritation was so great that excoriations and scabs were produced. On admission into hospital she was put into a warm bath, her clothes were destroyed, and every precaution taken to remove all the insects; but in two hours afterwards her body was again covered with lice, although she had been laid in a clean bed. She was again thoroughly washed, but the vermin re-appeared immediately. Some of the insects and their ova no doubt remained adhering to the skin, hidden amongst the scabs of the

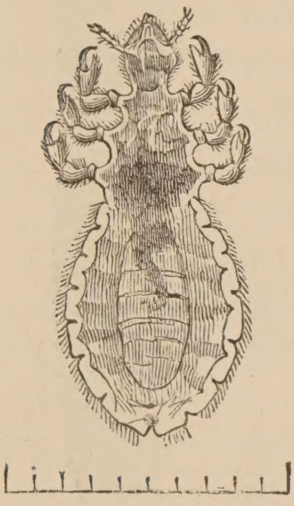
100ths of an inch × 10 diameters.

Fig. 34.*

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* *Pediculus corporis*—female (after ANDERSON).

excoriations; and they are known to multiply with a rapidity proportioned to the favourable nature of the soil afforded by the morbid condition of the skin of the affected person (ANDERSON, l. c., p. 108). Bernard Valentin relates the history of a man, forty years of age, afflicted with insupportable itching over the whole body, and having his skin covered with little tuberosities. The physician, unable to assuage the itching, made an incision into one of the small tumors, and gave exit to an enormous quantity of lice of different forms and sizes. The same operation was performed on the other tumors with a similar result (quoted by ANDERSON, p. 110). The following instance is related by Dr. Whitehead, in his work *On the Transmission from Parent to Offspring of some Forms of Disease*, p. 173, and quoted by Dr. Tanner:—A farmer forty-three years of age, strong, and of sanguine complexion, contracted syphilis in April, 1840. Seven months afterwards he suffered from secondary symptoms. At the end of 1841 he became so annoyed by the presence of lice about his person, chiefly on the trunk, that he sought again medical aid and advice. He was scrupulously clean in his habits, and had never before been troubled with these vermin. They increased in number, and produced such mental distress that fears were entertained for the integrity of his intellect. An examination of the skin showed a multitude of irritable-looking points on the front and sides of the chest, from which *nits* could be detached by lateral pressure. At this period the generation of the lice was so considerable and rapid that a flannel vest put on clean in the morning was crowded with them by the end of twenty-four hours. The usual remedies had only a temporary effect, till *iodide of potassium* and *prussic acid*, taken internally, seemed to render the system unsuitable for the further development of the vermin.

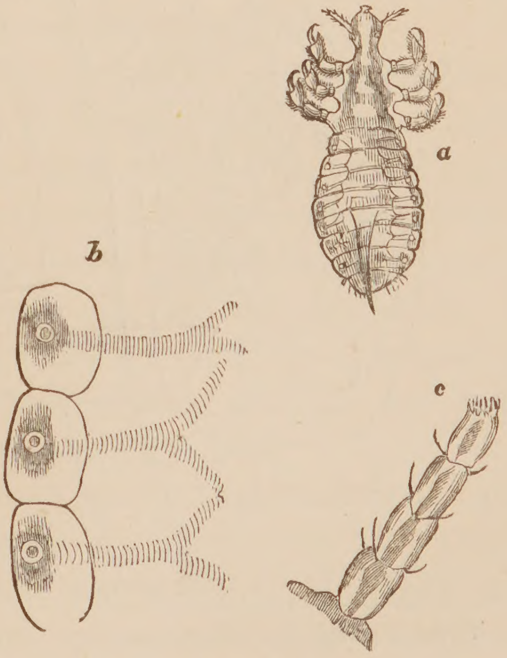

Fig. 35.*

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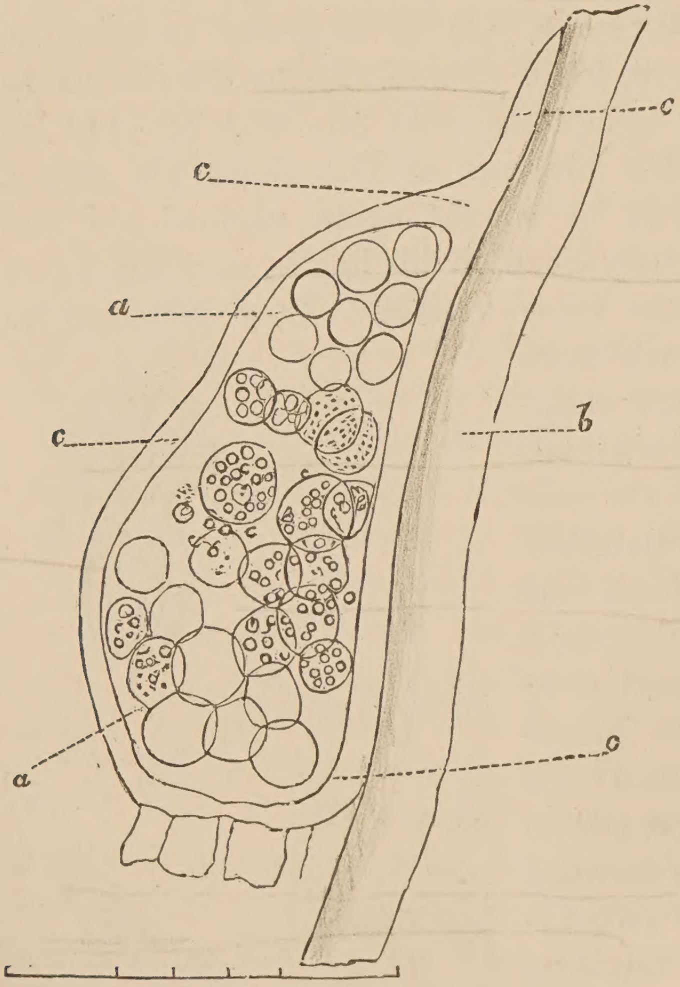
* (*a.*) *Pediculus capitis* (male); (*b.*) Trachea and stigmata; (*c.*) Antenna (after ANDERSON).

2. *The Head Louse* (fig. 35) is considerably smaller than the body louse just described. Its legs are larger in proportion to the size of the body than those of the *P. corporis;* and the abdomen is more distinctly divided into seven segments, separated from each other at the margins by deep notches.

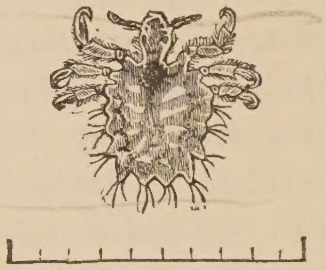
They propagate with astonishing rapidity, and by their irritation produce an *eczema,* from which the fluid exudes abundantly, and crusts are formed, involving the cuticular debris or exuviæ of the lice and the remains of epidermis. The hairs become glued together; partly by the fluid from the eczema and partly by the secretions of the insects as they deposit their ova in the capsules which they fix to the hairs (fig. 36). These capsules are commonly called *nits;* and they adhere with great tenacity to the hairs.



100ths of an inch × 200 diameters.

Fig. 36.*

3. *The Crab Louse* (fig. 37) has a shield-shape, and a much broader body in proportion to its size than either of the other two forms of lice; and there does not appear to be any distinct separation between its thorax and abdomen. It has been met with on all the hairy parts of the body except the head,



100ths of an inch × 10 diameters.

Fig. 37.†

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* *Nit,* or Egg Capsule of the Louse, fixed to (*b*) a hair, by the glutinous secretion (*c*, *c*, *c*, *c*).

† The Crab Louse (after Anderson).

but more especially on the hair of the *pubis*. It does not run about like the other lice, but grasps the stems of the hairs with its fore legs, and adheres so firmly that it is difficult to remove it without pulling out the hair. The *nits* or egg capsules are attached to the hairs in the same way as on the head. Pruriginous or eczematous eruptions, which may become pustular, are the results of their existence (ANDERSON).

Treatment consists in the destruction of the insects and soothing the irritation. To accomplish the death of the parasites the following substances are efficient—namely, *sulphur, mercury, staphisagria, sabadilla, pyrethrum, the essential oils, and alcohol* (ANDERSON).

Sulphur is used in the form of vapour baths or fumigations, or the simple or compound sulphur ointment of the pharmacopœia.

Mercury may be employed as simple mercurial ointment, or by fumigations with *cinnabar*, or in solution of the bichloride, in the proportion of two to three grains to an ounce of water, to which some alcohol has been added.

Staphisagria is employed as an ointment in the proportion of an ounce of *staphisagria* with four ounces of lard; or an infusion of *staphisagria* may be made with vinegar.

Sabadilla may be used in powder or as an ointment; an ounce of lard being used to incorporate a drachm of *sabadilla.*

The hair should be cut short when lice infest the head; and a lotion of the *bichloride of mercury*, or some of the ointments above named, applied at once to cause the death of the insects. The *nits* may be dissolved away by *alcohol* or *dilute acetic acid* (HEBRA). The scalp should afterwards be repeatedly washed in warm water with soap, and the eruptions treated according to their nature.

Sometimes the nits and the debris of the lice are involved in the substance of these eruptions, so that care must be taken to kill any insects that may remain and be so hidden.

With regard to body lice, it is necessary either to destroy the clothes, or to expose them to a temperature of at least 150° Fahr., by steaming them, or ironing them over with a sufficiently hot iron, or to boil them. In extreme cases, such as those related at page 961, it has been found that a mixture of iodide of potassium and prussic acid in full doses cured the diseased state of the system which favoured the development of lice in such numbers. After sixteen or eighteen doses in the case recorded by Whitehead, the cure was permanently completed.

The *Pediculus pubis* is best got rid of by rubbing a lotion of bichloride of mercury amongst the roots of the hairs, taking care that it is brought in contact with every insect. The application should not only be applied to the hair of the *pubis*, but to that in the neighbourhood, such as that of the *scrotum*, *perinæum*, and *anus;* and the application should be continued twice a day for a week at least. Mercurial ointment is equally efficacious; but care must be taken not to induce salivation: the hairs, rather than the skin, are the parts on which the lotion or ointment ought mainly to be applied.

SCABIES—Syn., ITCH.

Latin Eq., *Scabies*—Idem valet, *Psora;* French Eq., *Gale;* German Eq., *Scabies*—Syn., *Krätze;* Italian Eq., *Rogna.*

Definition.—*An eruption of distinct, slightly acuminated papules or vesicles, accompanied with constant itching, due to irritation caused by the burrowing underneath the epidermis of a female Acarus* (Acarus scabiei *vel* Sarcoptes hominis), *for the purpose of deposting her eggs.*

Pathology.—The full-grown *itch spider* or *Acarus* is of a whitish-yellow colour, and is just visible to the naked eye. The female (fig. 38) varies in size from $\frac{1}{7}$th to $\frac{1}{4}$th of a line in length, and from $\frac{1}{10}$th to $\frac{1}{6}$th of a line in breadth. It is of an ovoid form, broader anteriorly than posteriorly. The anterior segment carries the head and four limbs, two on each side of the head, which are set very close to it. The *head* projects considerably beyond the body, is of a rounded form, and marked by a central fissure provided with mandibles. The limbs are altogether eight in number, the four posterior limbs being

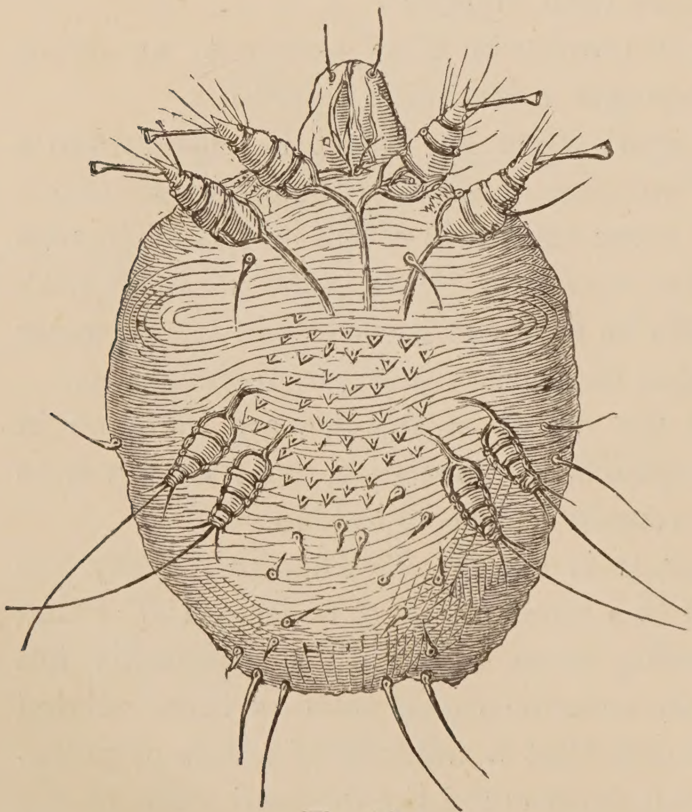

Fig. 38.*

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* *Acarus scabiei*—female (after Dr. T. Anderson).

placed about the middle of the under surface of the body. These limbs are of a conical form, tapering towards a point. They are each composed of several jointed segments; and the four anterior limbs are each provided with a stalked sucker. The extremity of each of the hind limbs terminates in a long curved *hair;* and several short hairs spring from beside the root of each sucker on the anterior limbs. The body is marked by numerous regularly disposed wavy lines; the dorsal surface is convex, provided with numerous little angular spines and little round tubercles, from each of which also springs a short conical spine. From each side of the body two hairs project; and four project posteriorly; so that, including those springing from the hind legs, the posterior half of the body is provided with twelve long hairs.

The male *Acarus scabiei* (fig. 39) is considerably smaller than the female, and the innermost pair of posterior limbs are provided with stalked suckers as well as the anterior limbs; while the parts corresponding to the genital organs are very distinctly marked (HEBRA, ANDERSON).

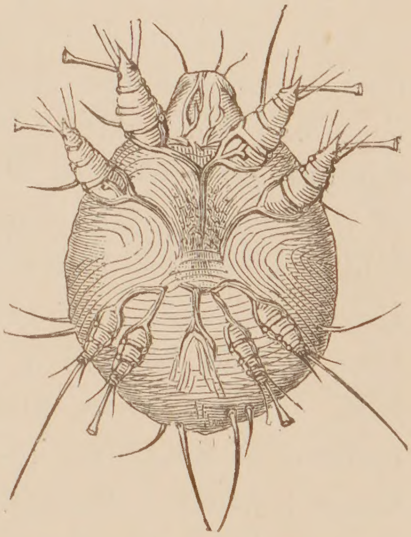
Fig. 39.

It is now impossible to say who discovered the itch insect. Avenzoar hinted at the existence of an *insect* in the vesicles of itch; but Moufet, in his *Theatrum Insectorum,* first mentioned it in a particular manner in 1663. Hauptmann first published a figure of it, and represented it with six feet. Redi Lorenzo, Cestoni, and Bonomo examined numbers of them, having removed them from the papules or vesicles of the skin. They discovered also the eggs of the parasite, and even observed their extrusion. Morgagni, Linnæus, De Geer, Wichmann, and Waltz confirmed these observations; but, nevertheless, the existence of the parasite up till 1812 was still called in question. About this time, therefore, a considerable prize was offered by the Parisian Academy of Sciences for its demonstration; and M. Galès, an apothecary of the St. Louis Hospital, tempted by the reward, is said to have defrauded the Academy and gained the prize (ANDERSON). His investigations are reported to have been witnessed by many members of the Institute; but, nevertheless, he managed to conceal beneath the nail of his thumb the common cheese-mite, and having opened with a lancet the pustule of a patient affected with scabies, he dextrously produced the cheese-mite from beneath his nail, pretending to have removed it from the patient (ANDERSON). Many others attempted to find the *Acarus* in the pustules or vesicles; and the circumstance of such men as Galeoti, Chiarugi, Biett, Lugol, and Mourouval having failed in finding the animal, occasioned fresh doubts regarding its existence. Their failures arose from having followed the cue given them by M. Galès in searching for the parasite in the papules or vesicles. Moufet had long before stated that they were not to be found in the pustules, but by their sides. Casal made nearly a similar observation; and Dr. Adams remarks that they are not found in the vesicles, but in a reddish line going off from one of its sides, and in the reddish firm elevation at the termination of this line, a little distance from the vesicle. Seventeen years after Galès' demonstrations the Academy discovered, through Raspail, that they had been defrauded: and in 1834 M. Renucci, a medical student from Corsica, showed the physicians of Paris the mode of discovering the *Acarus*, which is the same method as that which had been formerly mentioned by Dr. Adams. Since that time, as Rayer remarks, the existence of the *A. scabiei* has been placed beyond a doubt: and after the demonstrations of MM. Lemery, Gras, and Renucci (all of whom showed him the method of detecting it), Rayer has been able to extract it several times himself. Raspail has given an excellent description and figure of the parasite. M. Albin Gras enters into researches as to the share it has in producing the eruption, and he instituted experiments on the *Acarus* itself, which have an important bearing on the treatment of *scabies*. The habits and natural history of the parasite have been carefully investigated by Hebra; and Dr. Anderson has given an excellent account of these investigations, from which this description of the parasite and the disease is mainly taken.

The discovery of the male *Acarus* is claimed by several observers. According to Hebra, it was first discovered by Danielssen and Boeck in Norwegian scabies. According to Dr. Anderson, M. Bourgogne, the maker of microscopic preparations in Paris, claims to be the discoverer. According to Devergie, the honour is due to M. Lanquetin, a pupil of St. Louis.

It is the female only which burrows in the epidermis of the human skin. All the male *Acari* go free on the surface of the epidermis, where sexual intercourse between male and female *Acari* is said to take place. When an impregnated female is placed on the surface of the skin, it seeks a suitable spot to penetrate, and raising its head at right angles to the surface, it digs, burrows, or eats its way between the scales into the deeper layers of the epidermis, where it imbeds itself, derives nourishment, and goes through the process of parturition till she dies. Having found a suitable place, an egg is laid, and each day another, the animal penetrating a little further each time, leaving its deposited eggs to occupy the space previously inhabited by itself. The direction of the canal is oblique, the portion first formed being of course nearest the surface. As the old epidermis is thrown off, new layers of cuticle being formed from the deeper strata, the first-laid eggs are gradually thrust upwards to the surface, where they are finally extruded, while the recently deposited ova remain in the canal close to the parent female, whose instincts lead her to make the canal in such a way that her eggs reach the surface about the time the young ones are ready to come out of the shell. The newly hatched *Acari* (males and females) having arrived at the surface, crawl about the skin, and enter into sexual congress. The females in due time become impregnated, and, like their parent, repeat the process of burrowing and parturition just described. The length of time which intervenes between the laying and hatching of an egg is said to be *fourteen* days; and as the *Acarus* is found to lay one egg daily, there are rarely more than fourteen eggs in one canal at a time. The canals (cuniculi) which the female *Acari* burrow have a serpentine shape, and vary from half a line to three lines long. Hebra, and Dr. Reid, of Glasgow, have seen them three or four inches in length; and Hebra mentions that they sometimes completely surround the wrist like a bracelet. These canals have generally a whitish dotted appearance, the dots corresponding to the ova in the canals; and at the extremity of each canal is a little whitish elevation, which corresponds to the site of the parturient or defunct female *Acarus*. This whitish elevation is generally about a quarter of a line distant from the papule or vesicle; and the skin should be cleaned before endeavouring to detect it. After the death of the *mother Acarus*, the epidermis which covered in the canal gives way, as the cuticle grows and desquamates; there is then left at first a depression, or open ragged furrow, bounded on each side by a ragged edge of epidermis; and as these edges become dirty, the remains of the canal present a dirty ragged line. Besides the *Acarus* and its eggs, numerous little oval or rounded blackish spots are seen in these canals, which are supposed to be the excreta of the parasites; and after the female has once entered its canal it is unable to recede, owing to the spines on its body, which project backwards. It therefore dies in the canal when parturition is finished. The eggs of the *Acarus* vary much in size, according to their age and development; and just before the larva has burst its shell the egg is almost as large as the male *Acarus*. In the earliest stages the egg is very small, and filled with a granular-like matter (fig. 40, *a*).

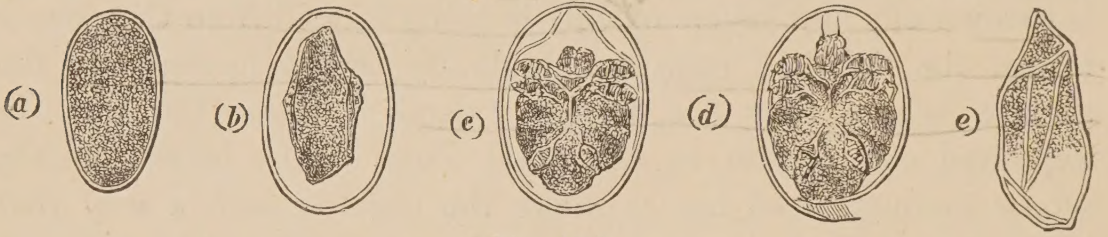

Fig. 40.*

It grows in the canal; and as it increases in size its contents seem to shrink and recede from the shell, and to have a distinct enveloping membrane. The bright yellow colour of the embryo contrasts strongly with the clear, almost colourless, walls of the egg-shell (fig. 40, *b*, *c*, *d*). The head and legs of the embryo soon become distinctly visible, and at last the whole form of the *Acarus* (fig. 40, *c*, *d*). Finally, the shell bursts, and the young *Acarus* escapes, leaving its shrivelled envelope (*e*) behind. The larva or young (fig. 41) differs from the full-grown insect in the possession of two hind limbs only, in place of four. By and by, however, it casts its coat, and then appears with eight legs; and sometimes even

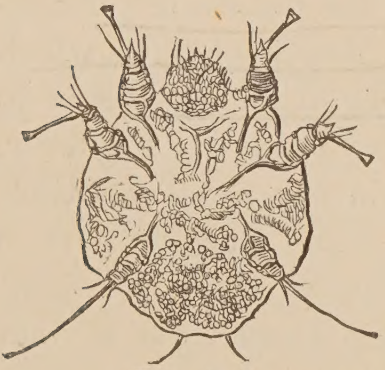

Fig. 41.†

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* (*a*.) Egg in the first stage; (*b*.) In the second stage, their granular contents being yellow; (*c*.) Egg in the third stage, the form of the *Acarus* becoming apparent; (*d*.) The egg in the fourth stage, the *Acarus* having broken the shell; (*e*.) Egg-shell after the escape of the *Acarus* (after Dr. T. Anderson).

† Larva or young *Acarus scabiei*—having only two hind legs (after Dr. T. Anderson).

the full-grown *Acarus*, with its eight legs, may be seen inside of its old six-legged skin, and thus renders the history of its development complete.

Symptoms.—The phenomena of the eruption of scabies are more often papular than vesicular; and the markedness of these phenomena depend partly on the length of time that the person has been affected, the number of *Acari* developed, and the degree of sensibility of the skin. It is known to infest sheep and dogs (YOUATT); and therefore hair does not preclude its existence; but it seems to prefer delicate parts of the skin—for example, the inner surfaces of the fingers, and folds of the skin between the fingers, the wrists and palms of the hands, the penis in the male and nipples in the female, as well as the hips, the feet, the umbilicus, and axillæ. in children the buttocks, palms & under [illegible] of sole

Itching, increasing at night, first attracts attention, and is a characteristic symptom. It becomes general all over the body, and the scratching aggravates the eruption. The *prurigo* of itch is generally most expressed on the forearm, lower part of the abdomen, and the upper and inner part of the thighs. Vesicular eruption is most usual on or about the fingers and nipples of females; and pustules may be met with in children whose skin is delicate, especially on the hands, feet, and hips.

There is a severe form of scabies common in Norway and some parts of continental Europe, in which the greater portion of the skin of the body becomes thickened, the natural furrows increase in depth, the pigmentary deposit is greatly augmented, and a fine white desquamation covers the surface. Here and there papules may be seen, either with dots of coagulated blood, or with whitish crusts on their summits. In these crusts portions of *Acari* and their exuviæ, excrement, and eggs may be found. The hairy scalp, covered with a crust which adheres firmly, of a bark-like consistence and yellow colour, is studded with fine openings for the hairs, which are glued together. On the under surface, and in the furrows of this crust, multitudes of *Acari* may be seen. Such are the main features of a case recorded by Bergh, of Copenhagen, and related by Dr. Anderson in his excellent little treatise already referred to. The itching was intolerable. The crusts were principally composed of the *Acarus*, its exuviæ, excrement, eggs, and egg-husks (fig. 42). A piece of the most superficial and dense part of the crust, less than half a line square, contained 2 female *Acari*, 8 six-legged young, 21 pieces of *Acari*, 6 eggs, 53 egg-shells, and about 1,030 pieces of excrement. "In the deepest and softest parts of the crusts, amongst the remains of deceased generations—partly in holes and passages, partly between particles of the crusts, partly on their free surfaces, masses of living *Acari* wallowed and tumbled about." The cases in which such a severe form of *scabies* has occurred have been characterized by extreme filth and neglect of treatment, and the irritation and course of the disease has tended to a fatal termination by pneumonia and hyperæmia of the brain.

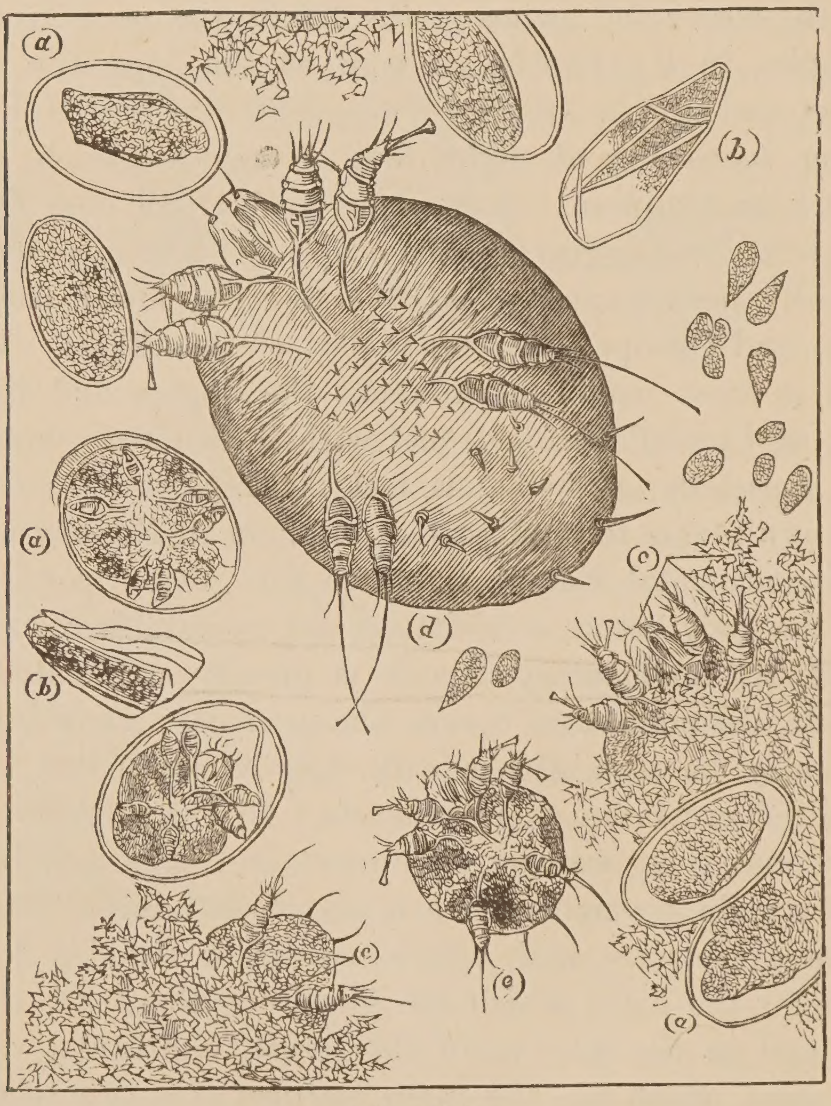

Fig. 42.*

Treatment.—Such applications are to be made to the skin that,

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* Crust from a case of the so-called *Scabies Norvegica* which occurred in Würtzburg.—(*a, a, a.*) Eggs of the *Acarus* in various stages of development; (*b, b.*) Egg-shells; (*c, c.*) Fragments of *Acari;* (*d, d.*) Female *Acarus;* (*e.*) Larva. The little oval irregular-shaped masses are presumed to be the excrement (after Anderson).

℞ Sulphuris ʒß (Fox)
Hydr. Ammonio: Chlor. gr iv
Creasote ♏ iv
Oleum Anthemidis ♏ x
Lard ℥i — To all Papules & Pustules

while they tend to kill the *Acari*, they will not increase the irritation of the dermis; and if the *Acari* are thus destroyed, the eruptions will in general subside in due course.

If much irritation of the skin prevails, warm baths are to be prescribed, and opium may be given internally.

In healthy adults the whole body of the patient ought first of all to be thoroughly scrubbed over with good black (soft) soap, and the process continued for at least half an hour. The patient should then get into a warm bath, in which he should remain for another half hour. Having thus washed and dried himself thoroughly, he is to rub himself over with the following ointment:—

℞. Subcarbonatis Potassæ, ʒi.; Sulphuris, ʒii.; Axungiæ, ℥xii.; *misce.*

Next morning a warm bath is to be taken, to clean the surface of the body from the remains of the anointing of the previous night. The cure ought now to be complete, so far as the destruction of the *Acari* are concerned (HARDY, HELMERICH, ANDERSON). The genuine pomade of Helmerich is one-third stronger than that which has been just quoted from Dr. Anderson, who considers it too irritant. The potash in the black soap and ointment acts as a solvent of the epidermis, and thus allows the sulphur to come into more immediate contact with the *Acarus*. A warm bath and plenty of hot water ablution completes the cleansing process.

The treatment may, however, be inapplicable to children, females, and men with delicate skins, or constitutional affections of the skin.

In them, although the principle of treatment is the same, the process of cure must be more slowly conducted by less powerfully irritant substances. The patient having cleansed himself thoroughly in a warm bath, with ordinary yellow soap, the following lotion may be applied:—

℞. Calcis, ℥ss.; Sulphuris, ℥i.; Aquæ, ℥viii. These ingredients are to be boiled and stirred constantly till a homogeneous mixture is produced, which is to be strained through a sieve.

These ingredients ought to produce a quantity more than sufficient for one person, and should be rubbed into the skin, not too roughly, every night for several evenings. The cases of scabies in the Belgian army are treated by this lotion (VELMINSKZ, ANDERSON).

When the person affected is predisposed to *eczematous* eruptions, the following application is recommended:—

℞. Sulphuris, Olei Fagi, ā ā ʒvi.; Saponis Virdis, Axungiæ, ā ā lbj.; Cretæ, ʒiv.; *misce.*

This ointment should be well rubbed in, after the skin has been prepared for it by the use of the warm bath and cleaning the body with common yellow soap. The potash in the black soap of the ointment acts as already stated, the chalk tends to remove the epidermis mechanically, the tar counteracts the tendency to eczema, and the sulphur destroys the *Acari.* The ointment ought to be left on overnight (if the skin is not too irritable), and should be washed off in the morning (WILKINSON, HEBRA, ANDERSON). Specific printed directions should be given to each patient; and cards are useful for this purpose, similar to those in use in the Dispensary for Skin Diseases in Glasgow. The following are the directions *printed* on each card, and which is given to each patient along with the quantity of ointment required:—

> "1st. Scrub the *whole* of your body (except the head) as firmly as possible, without hurting yourself, with black soap and water.
>
> "2d. Sit in a hot bath for twenty minutes, or if you cannot get a bath, wash yourself with hot water thoroughly.
>
> "3d. Rub some of the ointment firmly into the skin of the whole body (except the head) for twenty minutes. Let the ointment remain on the body all night.
>
> "Repeat these processes every night for three nights, and then return to the dispensary.
>
> "Besides, put all your washing clothes into boiling water, and iron all your other clothes *thoroughly* with a hot iron."

If such methods are systematically carried out, itch cases ought never to occupy hospital beds, either in civil or in military life.

The ordinary compound sulphur ointment of the pharmacopœia is also an efficient remedy. The cure being complete so far as the person is concerned, care must be taken to destroy the *Acarus* and its eggs which may be amongst the clothes of the patient. For this purpose they should be exposed to hot air at the temperature of at least 150° Fahr., or, if possible, boiled in water, or exposed to the action of sulphur by steaming them amongst sulphur vapours.

SECTION III.—EPIPHYTES—*Vegetable Structures; and the Pathology of the Lesions with which they are associated.*

These parasites are microscopic growths which belong to the lowest class of vegetable existence—namely, the *Fungi Cryptogamia.* Most of them are composed of simple sporules, germs, or of cells placed side to side or end to end.

Although much has been written on the influence of *fungi* in the production or aggravation of disease in the animal as well as in the vegetable kingdom, yet the subject is involved in much confusion, because in a few instances only have the persons recording their experience been sufficiently acquainted with the botanical nature of *fungi* in general, so as to give anything like a complete history of the cases which have fallen under their observation. Mere *mycelia* have been described as perfect plants, and mistakes have been made in important points of structure. Productions of an undoubted fungoid nature have been referred to *algæ,* although agreeing with them neither in habit nor in physiology, while the commonest moulds have received new names; and several conditions of the same species have been recorded as productions differing in their mechanism and physiological laws (BERKELEY). *Fungi* are the most numerous of all plants in regard to genera and species, and their growth is associated with most extensive injury to animal and vegetable life; and as they are now proved to be capable of propagation by implantation from animals to man, they demand from the physician a most careful study. The diseases of plants as well as animals have hitherto been almost neglected by the pathologist; yet how do we know that the *blights* of plants, or the causes of them, are not communicable to animals and to man? It is known how intimately the diseases of man and animals are related with the occurrence of famines and the prevalence of unsound or unwholesome food, and of famines with the diseases of vegetable and animal life, as much as with the destruction and loss of food. The black sporules of *Ustilago hypodytes,* which cause disease in grasses in France (the grass smut), and those of *Ustilago vittata,* which cause similar disease in the grasses of India, are known to produce most injurious effects upon the haymakers in the former country (LEVEILLE). In places favourable to the multiplication of *fungi* they often commit extensive ravages. Among the silk-worms in the silk manufactories of Italy, *fungi* are the cause of more extensive destruction of such animals than we have any correct idea of. Under the names of "mildew," "blight," "smut," "brand," and the like, *fungi* commit extensive damage among living plants, as the farmer and orchardist know too well. It has been asserted that *fungi* are uncommon in tropical countries; but it is doubtful if this is true; and the *fungus disease of the foot in India*, so well described by the two Carters, show that *fungi* are capable of giving rise to a disease almost dangerous to life in that country. It therefore behoves the pathologist to study carefully the nature of those diseases in animals and vegetables, as well as in man, whenever he has an opportunity, and especially in India. It is not in all cases easy to determine whether they are the cause of morbid states, or whether, as some think more likely, the diseased tissue has merely afforded a suitable nidus for their development. It is certain that wherever the normal chemical processes of nutrition are impaired, and the incessant changes between solids and fluids slacken, then, if the part can furnish a proper soil, the cryptogamic parasites will appear. The soil they select is for the most part composed of epithelium or cuticle, acid mucus or exudation. Acidity, however, though favourable for their growth, is not indispensable; since some of the vegetable parasites grow upon alkaline or neutral ground, as on the ulcerations of the trachea, or in fluid in the ventricles of the brain. Certain atmospheric conditions seem favourable to the occurrence of those vegetable parasites. For example, *Tinea tonsurans* may be quite absent for years in places such as workhouses, where it commonly exists, and then for several months every second or third child in the place gets the disease. It has been observed that some of these parasitic diseases can be propagated by transference of the plant, as in various forms of *tinea*, and that the disease can be cured with the greatest readiness by the chemical agents which are most destructive to vegetable life.

These vegetable parasites have been shown to be capable of transmission from animals to man. It has been recently proved by Devergie that *T. tondens*, for example, is transmissible by contagion from horses and oxen to man, and that the parasite has given rise either to the same form of *tinea* disease or to another; but he ascribes both species of parasitic disease to the growth of one and the same parasite—namely, the *Trichophyton.* Von Bärensprung, of Berlin, bears similar evidence. He rubbed on his forearm some of the scales of *tinea* from one of the lower animals, containing abundance of the spores and mycelium of the fungus *Trichophyton.* No effect was produced for several days; but after a longer interval considerable itching called his attention to the part, which he found occupied by a well-marked spot of *T. circinatus* about the size of a sixpence. In three weeks the patch increased to the extent of a crown-piece (*Brit. and For. Med.-Chir. Review*, July, 1857, p. 263).

Instances have been noticed of grooms being attacked by *T. circinatus* and *sycosis* after grooming horses affected by *T. tonsurans.* "A dragoon came to the Dispensary of the St. Louis Hospital affected with *T. circinatus* on the front of the right forearm. He stated that five or six of his comrades had contracted this affection as well as himself from grooming diseased horses. A visit to the barracks showed three horses with round patches absolutely identical with *T. tonsurans.* These were situated on the withers, shoulders, back, and belly. The hairs in the centre of each patch were broken off close to the skin, and there was a whitish, squamous, crust-like production, which was traversed by the hairs. The presence of sporules was detected by the microscope. The dragoon who showed the horses showed also his daughter, a girl of eight or ten years of age, the side of whose nose exhibited a patch of *T. circinatus*" (BAZIN, quoted by Dr. Anderson *On the Parasitic Affections of the Skin*, p. 51).

With regard to the transmission of *favus* from the lower animals, I am informed by Dr. Anderson that, in the Dispensary practice of Glasgow, the physicians often find it traceable to contagion from mice, cats, and dogs similarly affected; but that mice are the animals which seem to be the ultimate source of the disease.

On the other hand, it is shown that animals may contract parasitic diseases of the skin from human beings similarly diseased. Dr. Fox mentions an instance of a white cat, a great pet with the children of a family of nine, which contracted the *mange* and *T. tarsi* from *T. tonsurans* affecting five of the children. The fungus of the *mange* in the cat is the same fungus as that of *Tinea* in man—namely, the *Trichophyton.*

The principal vegetable parasites associated in man with special morbid states have been enumerated as follows:—

1. The *Trichophyton tonsurans* vel *Achorion Lebertii* (ROBIN), which is present in the three varieties of *Tinea tondens*—namely, *T. circinatus* (ringworm of the body), *T. tonsurans* (ringworm of the scalp), and *T. sycosis menti* (ringworm of the beard).

2. The *Trichophyton sporuloides* (VON WALTHER), together with the above, which are present in the disease known as *Plica* vel *Tinea polonica.*

3. The *Achorion Schönleinii* (REMAK) and the *Puccinia favi* (ARDSTEN), which are present in *Tinea favosa* (the honeycomb ringworm).

4. The *Microsporon mentagrophytes* (GRUBY) which is present in *Sycosis* or *Mentagra.*

5. The *Microsporon furfur* (EICHSTÄDT), which occurs in *Pityriasis* vel *Tinea versicolor.*

6. The *Microsporon Audouini* (GRUBY), which is present in *Porrigo* vel *Tinea decalvans* (*Alopecia areata*).

7. The *Mycetoma* vel *Chionyphe Carteri* (H. V. CARTER, BERKELEY), which gives rise to the disease known as "the fungus foot of India,"—a cotton fungus occurring in the deep tissues and bones of the hands and feet.

8. *Oidium albicans,* or "thrush fungus" (ROBIN) of diphtheritis and aphtha.

9. *Cryptococcus Cerevisæ* (KÜTZING), *Torula Cerevisiæ* (TURPIN), yeast plant in bladder, stomach, &c.

10. *Sarcina ventriculi* (GOODSIR), or *Merismopœdia ventriculi* (ROBIN), in the stomach.

It would have been better if these *fungi* had been described in the first instance without specific names. The fact of specific names having been assigned to each of them has drawn attention from the important part which these *fungi* perform in the work of decomposition. They may be forced to fructify by placing them in a globule of water surrounded by air, and placing them in a closed cell; and until the fungus has thus come to maturity it is worse than useless to give them names—so many different forms in an undeveloped state being all capable of reference to one common mould (BERKELEY).

The plants forming on mucous membranes, or in the contents of cavities lined by mucous or serous membrane, are in most cases only of secondary formations, and their exact pathological significance is unknown.

The pathognomonic sign of all the parasitic lesions of the surface in man and animals is the infiltration or destruction of hairs (*tinæ*) and epithelial textures (*muguet, thrush, öidium*) by the *sporules* of a fungus, and which, by union or by growth, form elongated branches, or *mycelium.**

The diagnosis of such *fungi* on the skin, hair, or epithelium can only be effected by a careful and skilful microscopic examination; and it is always absolutely necessary to use the *liquor potassæ* in the examination of all *tonsurant* appearances of the hair, of all *idiopathic* bald patches, and of all brown or yellow-coloured scurfs, for sporules are frequently detected which had escaped observation before *liquor potassæ* had been used (BAZIN, FOX, ANDERSON). Sufficient time must also be allowed for the parts to become transparent under the action of this re-agent.

The parasitic lesions of the skin are, as a rule, unsymmetrical, and hence they differ materially in this respect from syphilitic cases. They differ also no less essentially from the eruptive diseases of the skin. An eruption is no necessary part of these parasitic lesions; but, from the irritation established in the true skin, eruptions of various kinds may occur. Eruption thus often precedes the detection of a fungus, and, as a rule, very often follows its existence; and they who dispense with the microscope in the diagnosis of skin affections cannot avoid confounding severe eruptive with parasitic lesions, because they disregard the pathognomonic evidence of such lesions already indicated (FOX). The term *herpes*, therefore, as applied to these parasitic affections, is an objectionable term; because it has been already used to indicate a vesicular eruption, namely, *herpes zoster*, which invariably exhibits large typical vesicles.

There seems to be a peculiar condition of nutrition best fitted for parasitic growths of a vegetable nature, just as some constitutions and states of the system are best suited for the propagation and development of entozoa; but the exact circumstances which predispose to the growth of these *entophytic fungi* upon the human body are not better known than those which predispose the body to receive and develop certain morbid poisons of a specific kind, known to multiply during the course of the disease, and to throw off material capable of propagating and spreading the same kind of disease. With regard to the parasitic diseases of the skin and hair, a failure of the vital powers to carry on the healthy processes of life seems ordinarily to be one of the inviting causes of such a development of true *fungi* as would constitute a disease. A special nidus or soil is necessary, just as a predisposition is necessary in the case of the spread of miasmatic diseases; yet care must be taken in both instances not to confound the co-operating cause with the special or peculiar poison or germ. Both Robin and Bazin recognize a condition of the hairs (dependent, perhaps, on constitutional causes) which appears to be essential for the growth of the plant; for sometimes the disease disappears spontaneously, and the fungus dies without treatment.

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* These *fungi* have sometimes been popularly but erroneously termed *confervæ*. The *confervæ* belong to the *algæ*, and for the most part grow in salt or fresh water.

The evidence is now very strong which points to the various *fungi* already mentioned as mere varieties of two or more species (Hebra, Lowe, Hogg, Fox, Berkeley).

There are numerous facts which justify the belief that there exists but one essential fungus, whose sporules find a soil for development and growth upon the surface, or even within more secluded portions of the human body; and that varieties in the growth of that fungus are due to differences in the constitution of the individual, to the moisture, exudation, soil, or temperature under which the development of the fungus takes place. The exact nature of these differences is not yet understood; but the production of irritant acids and gases are constant accompaniments of the growth of such parasites, by the chemical action of the vegetable cell; for it does not undergo development without exciting a chemical decomposition in the pabulum on which it feeds; and the different stages in its growth give rise to alcoholic acid and putrefactive fermentation. Of the latter there is ample evidence in many of these parasitic skin diseases, and especially in favus, the odour of which closely resembles that of some *methylamine* compound (Lowe). Thus their irritant action very soon may establish an eruption. But the ratio of eruption to parasite is not constant; for an amount of fungus which will simply produce death of hair in one person or part of the body may in another produce irritation, eruption, or violent inflammation. These different results may be due to two causes,—(1.)

Constitutional peculiarity in different individuals; (2.) Peculiarity of structure of a part as regards density, heat, moisture, and chemical and anatomical composition of the part. Not only do these fungus sporules penetrate hairs, hair follicles, and epidermic cells, but the development of sporules of a similar nature within the *bones* and deeper textures constitutes a most serious disease of the foot in India, about to be described.

It is not to be hastily concluded that a disease is non-parasitic because a fungus has not been demonstrated in the part where it was expected to exist. The minuteness of the sporules, and the care required in the investigation, sufficiently explain the very various opinions which have prevailed on the nature of these parasitic lesions (LOWE). To appreciate the ravages which may be produced by such minute cells, the reader may be reminded of the immense force which the growth of such cells is capable of producing through continuous and gradual development; for, being of so minute a form, and its agency so apparently invisible, its intrinsic power is apt to be underrated. An *Agaric* growing under a stone of more than a hundred pounds' weight will eventually raise it from its bed to the height of several inches; and the cells of that *Agaric* are not widely different from the *sporules* of a fungus. Again, the *mycelium* of a fungus (probably identical with that found in skin diseases) has been known to raise a cask of wine, the fungus feeding on the wine as it leaked from the cask (HARVEY, quoted by Lowe in *Lancet* of August 13, 1859).

The variations of form in these different vegetable parasites associated with the skin disease about to be described are obviously so slight that they seem insufficient to warrant different species being made out of them. They may all be initial or undeveloped forms, referable to the *Aspergillus glaucus* or *Penicillium;* the initial forms of both of these being isomorphous (LOWE); and both of them are also equally indifferent about the matrix where they grow, as long as the conditions for their growth are fulfilled (BERKELEY). Peculiarities have also been observed in the growth of the fungus, which may be explained as due to the stage of development and conditions of growth at the time it was examined (*Path. Society Trans.*, vol. vii., p. 395). The same *fungi* during their growth are known to assume very different forms and appearances. It thus happens that the same species has not only been described under different specific names, but even referred to different genera. Fries states that he has traced no fewer than eight genera of different authors to mere degenerations or imperfect states of one particular fungus (*Thelephora sulphuria*); and Nees von Esenbeck states that the same fungoid matter which develops a certain fungus in winter (the *Sclerotium mycetospora*) will develop another fungus in summer (the *Agaricus volvaceus*). Professor Henslow showed that some of the supposed species of *Uredo* are forms of *Puccinia*, *Aregma*, and the like.

The identity of these *fungi* associated with skin disease has been likewise proved by clinical observation. In patients affected with ringworm of the head (*T. tonsurans*), patches of ringworm of the body (*T. circinatus*) are frequently seen on other parts of the skin, more especially on the neck, where the patches of the skin and scalp are often continuous (JENNER, ANDERSON). Instances of the converse of these observations are recorded by Dr. Fox, where the disease from the skin extended upwards to the scalp, with the characters of *T. circinatus* on the skin and *T. tonsurans* on the scalp (*Lancet*, Sept. 17, 1859). Hutchinson states that once, in examining with the microscope the parasite from a case of *T. tonsurans*, he inoculated himself by mistake, and there resulted a well-defined patch of *T. circinatus* on one side of the neck (*Med. Times and Gazette*, Jan. 12, 1861). Dr. Anderson mentions that in cases of *sycosis* he has more than once found the external aspect or back of the hand or wrist the seat of *T. circinatus*, owing to the patient rubbing the itchy and diseased portions of the chin with these parts, thus giving an opportunity for the transmission of the parasite (*Parasitic Affections of the Skin*, p. 50). The ringworm of the skin, he also observed, might give rise to *sycosis*. Dr. Fox relates that while examining a patient with *T. circinatus* he had two or three vesicles of *simple herpes* just appearing at the time on his own lip. The fungus became implanted amongst these vesicles; and the herpetic eruption became irritable, inflamed, and pustular; and the hairs at their cut ends were actually split up by the fungus, which was making its way down to the follicle.

Sycosis is also shown to be produced from *T. tonsurans;* but Dr. Lowe has shown that *favus* and *sycosis* may be produced from the implantation of the yeast plant; and the large oval spores of *Achorion* have been seen in *T. tonsurans* (RACIBORSKI, FOX); and *chloasma* may be produced from the implantation of *Oidium*, or fungus of the "thrush" (FOX). The nail fungus is an *Aspergillus* (VIRCHOW), or an *Oidium* (KUCHENMEISTER), or an *Achorion* (MEISSNER); while the ear fungus is an *Aspergillus* or a *Mucor*. The figures used in illustration of the text (kindly lent by Dr. Anderson) show the sameness in the form of the fungus in those parasitic diseases; and if contrasted with fig. 27, page 79, of Dr. Bennett's admirable work on *The Principles and Practice of Medicine*, showing the sporules and mycelium constituting the *muguet* of infants, and with figs. 86, 87, and 88, page 99 of the same work, it cannot fail to strike the observer that the form and nature of the *fungi* peculiar to the diseases about to be described are really identical. Nevertheless, the lesions induced are sufficiently various to necessitate the description of separate diseases capable of clinical recognition, for the treatment varies with the aspects of the particular disease; and the clinical aspect of the disease is no doubt related to the stage of development, growth, or degeneration of the fungus.

RINGWORM—SYN., TINEA TONSURANS.

LATIN EQ., *Tinea tondens;* FRENCH EQ., *Tinea tonsurans;* GERMAN EQ., *Tinea tonsurans*—Syn., *Ringwurm;* ITALIAN EQ., *Tinea tonsurans.*

Definition.—*An affection implicating the hairs of the skin, scalp, or chin, and usually assuming a circular form. The hairs become dry and brittle, having a tendency to crack or break across. Itching accompanies the primary eruption, which is generally at first erythematous, with slight swelling, and a fungus ultimately appears* (Trichophyton tonsurans), *which had been developing between the epidermis and the true skin. The fungus has a pure white colour and powdery aspect. It covers the epidermis between the hairs, and forms around them a complete white sheath. Inflammation of the hair follicles and of the surrounding tissues occurs; and when pus forms, the fungus is destroyed at the expense of obliteration of the roots of the hair, when perfect baldness ensues* (BAZIN, ANDERSON).

Pathology.—The nature of this disease is to be studied in the botany of the cryptogamic parasite called the *Trichophyton*, discovered by Malmsten in 1845. It consists of oval transparent spores or globules, about the $\frac{1}{7000}$th part of an inch in diameter. Many of these are isolated; others constitute, by their juxtaposition, articulated filaments. Comparatively few cryptogamic tubes are visible—a character which distinguishes the ringworm affections from the vegetable structures seen in the other parasitic diseases of the skin (fig. 43). Its anatomical seat is in the *interior of the roots of the hairs.* The *hairs* and *fungi* simultaneously increase; the former seem larger than usual, are paler in colour, lose their elasticity, soften, and break off when they have risen some one or two lines above the surface of the scalp. In the short cylinder of hair left, the fungus grows still more rapidly, so that the normal structure of the small stump soon becomes undistinguishable. Sometimes the hair breaks off before emerging from the skin, and the fungus, epidermis, and sebaceous matter fill the ends of the piliferous conduits, and form the little prominences which can be seen by the naked eye in this disease, and which gives to the skin a rough anserine appearance. The sporules and mycelium of the plants can sometimes be seen in the form of a white powder on the roots of the broken hairs; sometimes the cutis becomes congested and thickened, and then the plant becomes mixed up with the scales of epidermis, with fatty and albuminoid granules, with pus and serous exudation, and so crusts are formed of greater or less thickness in which the growth of the fungus can go on. It exists in the *Herpes tonsurans* of Cazenave, which is the *Porrigo scutulata* of Willan, the *Tinea tonsurans* of Bazin, and the *Trichosis furfuracea* of Erasmus Wilson and Dr. Wood. The disease commonly called *Ringworm* is what is intended to be described by all those names now mentioned, and on which dermatologists cannot agree.

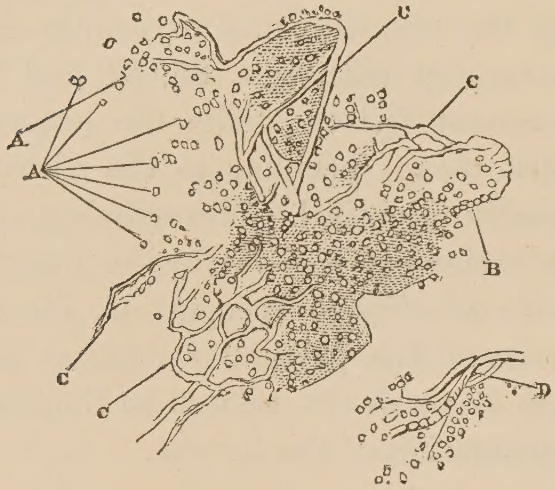

Fig. 43.*

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* Parasitic fungus from a case of *Tinea tonsurans.*—(A, A.) Isolated spores; (B.) Spores united at their ends; (C, C, C.) Empty tubes; (D.) Sporular tube (after Bazin).

There seems to be three varieties of this disease, which may be described under the following names:—

1. *Ringworm of the Body* (*Tinea circinatus*) commences by a little rose-coloured and slightly elevated spot, about the size of a fourpenny piece, which shortly becomes the seat of slight furfuraceous desquamation, accompanied by tingling or itching. The spot gradually increases in size, but retains its circular form; and as it extends, the healing process commences in the centre; so that in a short time the red spot is transformed into a large, prominent, erythematous ring, enclosing a portion of sound skin. This process goes on for an indefinite period, the ring gradually increasing till it may have a diameter of four or five inches. When the extent of surface affected is large, the circle is apt to become incomplete, so that various segments of circles appear. The disease may terminate spontaneously, the parasitic fungus being very superficial, the hairs small and rudimentary, so that the parasite dies for want of nourishment. It is apt to affect the face, the neck, the back, and outside of the wrist and hand (BAZIN, ANDERSON).

2. *Ringworm of the Beard* (*Tinea sycosis*) is met with on the upper lip and hairy parts of the cheeks, as well as on the chin, when it affects men; but the hairs of the axillæ or genital organs of females are not exempt from this disease. It commences exactly like *T. circinatus;* but it is not till the deeper structures are involved, and when small indurations

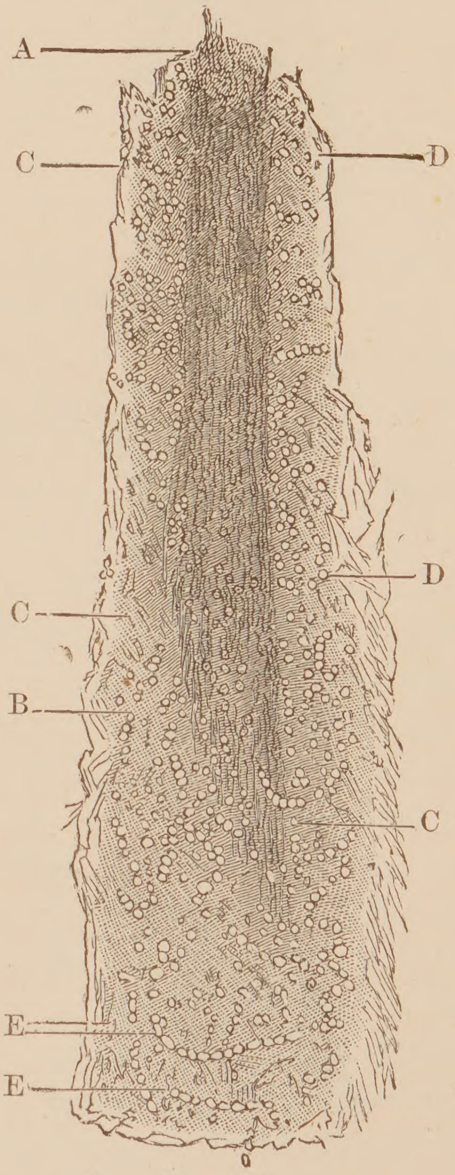

Fig. 44.*

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* Hair from a case of *Sycosis.*—(A.) Broken condition of the superior extremity of the hair; (B.) Rupture of the inferior extremity of the hair; (C, C, C.) Epidermic tunic of the hair; (D, D.) Isolated spores; (E, E.) Chains of spores (after BAZIN).

occur, surmounted by pustules resembling *acne*, and when the hairs can be pulled out with ease, that the attention of the patient is attracted to the affection. The hairs are thickened, the bulbs flattened and more or less disorganized. The longitudinal fibres of the hair are separated by masses of sporules imbedded between them; and where the fungus accumulates, nodes on the hair indicate the site of such accumulation. The medullary part of the hair is quite disorganized (figs. 44 and 45), and may disappear altogether. In the advanced stage of *sycosis*, when inflammatory and suppurative phenomena prevail, the fungus is difficult to find.

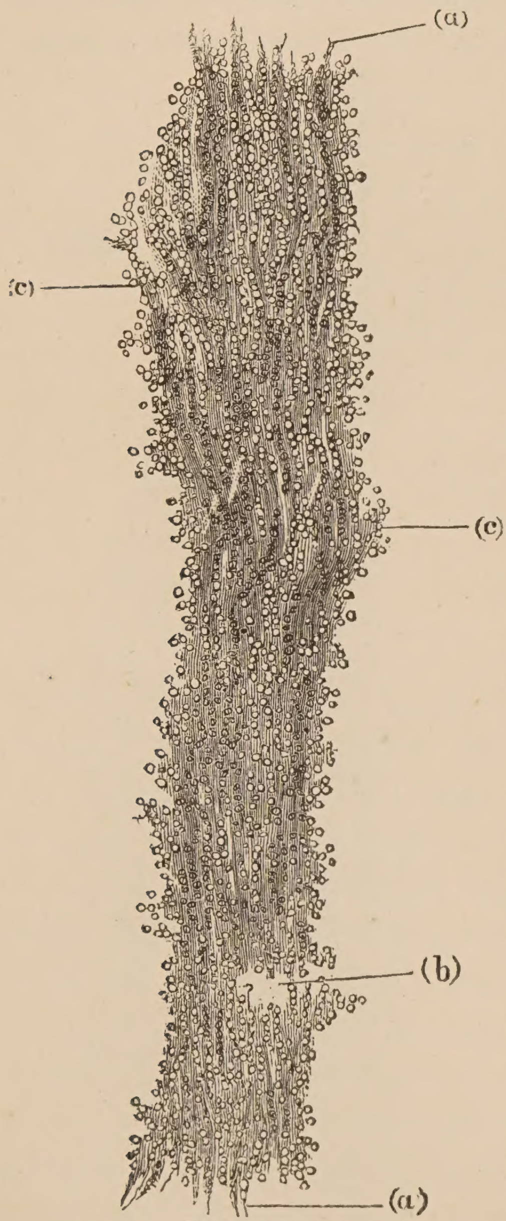

Fig. 45.*

3. *Ringworm of the Scalp* (*Tinea tonsurans*) is for the most part met with in children. It generally makes its appearance first in the form of rounded patches on different parts of the head, of a scaly or pityriasis-like inflammation. From the irritation induced small vesicles may form. The hairs in the first instance are dull, dry, twisted, and easily extracted; but as the disease advances they become very brittle, and break on attempting to extract them; and as they become more and more friable they break of themselves within a line or two of the skin (Bazin, Anderson). The twisting of the hairs, so frequently observed, is due to—(1.) Plugging up of the follicular orifice by secretion, and detention of the upper part of the shaft of the hair, while its growth at the papilla still continues. Half an inch in length of hair may sometimes be pulled from beneath the false

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* Hair from a case of *Tinea tonsurans* loaded with *sporules*.—(*a*, *a*.) Broken ends of the hair; (*b*.) Rupture of the longitudinal fibres; (*c*, *c*.) Ragged edges of ruptured hair (Dr. T. M. Anderson).

operculum. (2.) It may be due to the presence of *mycelium* in the follicle, clinging to the hair on one side and to the follicle on the other. It thus blocks up the follicle, and holds the hair (while still growing) to the diseased spot (Fox). The epidermis and stumps of the hair become covered over with a characteristic greyish-white powder, which ensheathes the hair. This powder consists of the *sporules* of the fungus. There is slight elevation and puffiness of the skin of the diseased parts, while its colour is bluish or slate-coloured in dark subjects, and greyish-red or yellow in fair persons (Bazin, Anderson). This elevation and puffiness of the skin is due to a granular layer or *stroma*, which, on the addition of *liquor potassæ*, is seen under the microscope to be due to *sporules* of the fungus closely packed together. The amount of fluid influences materially the size of the *sporules* (Robin, Fox). When pustules and yellow crusts form, the detection of the fungus is more difficult. The inflammation will last as long as the growth of *fungi* continues, but sometimes they die out spontaneously, and a perfect recovery takes place; but the hair follicles may be obliterated, when permanent *alopecia* of the affected parts is the result, with more or less atrophy of that portion of the scalp (Bazin, Anderson).

The Treatment of ringworm, writes Dr. Parkes, has been long one of the most difficult points in dermatology. Its principles, however, are now well understood, and few cases resist the proper measures. The essential point is to apply to the roots of the hairs a preparation which may destroy the fungus: if this can be done, the disease is cured. It is first of all necessary to remove the hair. This is in part generally accomplished before the case comes under treatment, by the course of the disease; if it has not been sufficiently done, "epilation" can be accomplished by a chemical agent, or by extraction with pincers (fig. 46). The forceps most suitable for this little operation are those about three inches long, having a weak spring, so that the hand may not be fatigued in using them. They should be made so that the two extremities come together very exactly, and do not slide the one upon the other. Each extremity should be a couple of lines broad, so that a fasciculus of hair may be caught up at one time when required; and should be furnished on the inside with very fine, but at the same time blunt, transverse denticulations,

R ol. Cade ʒß–i
Glyc ℥i

so that they may not cut across the brittle hairs. M. Bazin recommends an ointment composed of lime and carbonate of soda, of each one part, and thirty parts of lard, as an agent to remove the hair. The *oil of cade*, however, appears to be the best depilatory known, and with this mode of treatment epilation with the pincers may be combined. If the hairs are pulled out in the proper direction, there is very little pain, especially after the sensibility of the skin has been blunted by the use of the *oil of cade*. The removal of the hairs permits a "parasiticide" solution to be applied to the hair follicles, within which are the prolific spores of the fungus. For this purpose M. Bazin recommends either a solution of *bichloride of mercury* (1 part to 250 of water) or an ointment of the *acetate of copper* (1 part to 500 of lard), about *two* grains to an ounce of water; and a little *alcohol* or *muriate of ammonia* should be used to facilitate the solution of the mineral. The *oil of cade* should be mixed with *glycerine* in the proportion of half a drachm to a drachm of the oil to an ounce of *glycerine*. Kuchenmeister's experience shows that the alcoholic solutions act most powerfully.

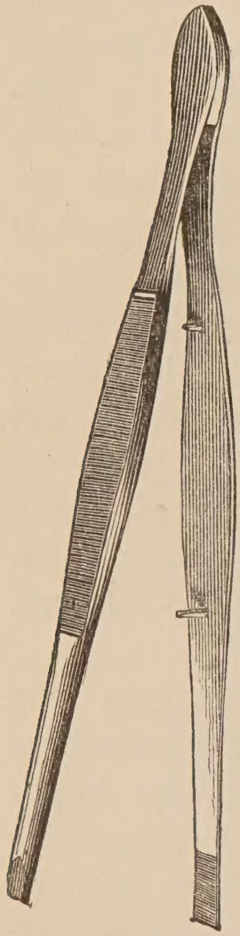

Fig. 46.*

Dr. Parkes has used, with excellent effect, a solution of the *pernitrate of mercury*, about one, part to thirty or forty of water. This is, however a very powerful remedy, and is to be cautiously used, as it easily blisters the scalp; also an ointment composed of sulphate of copper (one part), alum (three parts), and lard (twenty to thirty parts, according to the age of the patient). Probably, however, a better parasiticide than any of these is the *sulphurous acid* as employed by Dr. Jenner, of University College, London, with astonishing results. Dr. Bennett recommends the internal use of cod-liver oil at the same time. My friend Dr. Davidson has found the following method of treatment to succeed:—namely, to apply *tincture of iodine* to the affected parts twice a day for fourteen days, and afterwards ointment of the *bichloride* of mercury, (Coros. sublimat.) After the third or fourth application of the iodine, the disease will cease to spread, and the hair (which may have been thinning rapidly) will cease to fall off. A kind of crust is formed by the application of the iodine, which will scale off in the form of a scurf when the ointment is applied. Washing the head after the disease has commenced, and before medical treatment is begun, sometimes tends to spread the disease to parts of the head which had been sound before.

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* Forceps for epilation (Dr. Anderson).

FAVUS—Syn., SCALD HEAD.

Latin Eq., *Tinea favosa*—Idem valet, *Favus;* French Eq., *Tinea favosa;* German Eq., *Tinea favosa*—Syn., *Favus;* Italian Eq., *Tinea favosa.*

Definition.—*A fungus parasitic disease, composed of cup-shaped scabs, sometimes distinct and separate, at other times indistinct or confluent. These fungi* (Achorion Schönleinii, Puccinia Favi) *are capable of being implanted by transference from one person to another. The hairy scalp is its most common site, but the disease may be developed on the face, neck, or limbs.*

Pathology.—The disease has been found to depend on a cryptogamic fungus, which has been named the *Achorion Schönleinii,* after Schönlein, who was the first to suggest that the *yellow favus* crusts in *Porrigo lupinosa* and *P. scutulata* were constituted by a vegetable parasite. The disease with which it is associated is now called indifferently *Favus, Tinea favosa,* or *Porrigo scutulata.* The primary seat of the parasite is in the depth of the hair follicle, outside the layer of the epithelium which covers the root of the hair, and which forms the "inner root sheath" of Kölliker. By using a concentrated solution of *liquor potassæ,* to make the parts transparent, the fungus may be observed with the microscope in the follicle round the hair at the place where it passes through the epidermis. A second form of the disease is that in which the plant is found in depressions on the surface of the skin, forming the yellow honeycomb-like masses which gave the specific name *favus* to the disease, and which, from their frequent buckler-like shape, suggested the term "scutulata." A cuticular elevation is seen, beneath which is a small favus. When the cuticle is raised, a drop of pus sometimes issues; hence the error of those who have considered this disease always pustular. Generally, however, there is no pus or liquid of any kind: the plant grows, and the cuticle over it (supposing it has not been forcibly detached) finally separates, leaving the favus exposed to the air. A third form of the disease is that in which the fungus attacks the nails, and occurs for the most part in those who have been long affected with the favus of the hair follicles, the fungus taking root and germinating beneath the nail (fig 47). After the spores have commenced to germinate between the superficial and deep epidermic layers, the nail becomes thickened over the affected part, and its colour becomes gradually more and more yellow, owing to the favus matter shining through it. As the fungus increases in growth, it gradually presses on the nail, rendering its longitudinal striæ very evident, and ultimately leading to the formation of fissures in it. As the pressure on the nail increases, its substance gets thinner and thinner, till perforation occurs; and then a favus cup makes its appearance externally, but more or less deformed (ANDERSON).

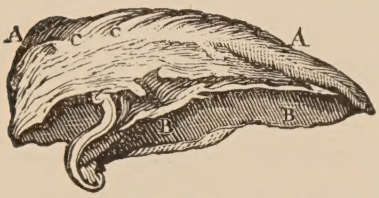

Fig. 47.*

It is important to notice that at first there is, at the point where the favus is about to form, only an increased secretion of epidermis; and sometimes the under surface of the favus is coated by cuticle, which separates it from the compressed and attenuated derma. As it increases in size, and becomes more prominent, the epidermic covering is ruptured. Each favus crust is also enveloped in a capsule of amorphous structure, within which is enclosed the true favus matter (fig. 48).

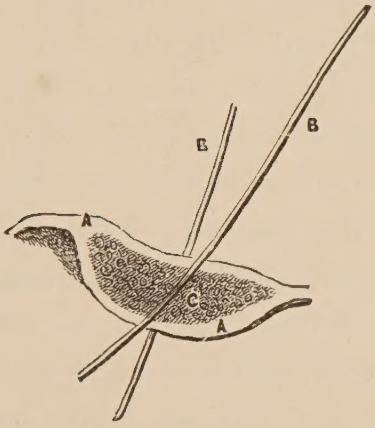

Fig. 48. †

The favus consists of the *mycelium*, the *spores*, and the *receptacles* of the *Achorion*, together with a finely granular amorphous layer, which forms the external coat of the favus, and is the representative of the amorphous "stroma" which often accompanies the mycelium of *fungi*. In the favus another and distinct fungus can sometimes be found—namely, the *Puccinia favi*—which is easily recognized: it has one extremity (the body) rounded and composed of two cells of unequal size, a superior and an inferior; the other extremity is prolonged into a jointed stem or trunk.

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* (A, A.) Upper surface of nail; (B, B.) Lower surface of nail; (C, C.) *Favus* matter (white in the wood-cut, yellow in the original), running upwards and forwards between the laminæ of the nail (ANDERSON).

† Favus cup.—(A, A.) Amorphous envelope; (C.) Favus matter; (B, B.) Hairs traversing the Favus cup (ROBIN).

When a little of the favus matter is broken up and examined microscopically, after being acted upon by solution of potash, it is seen to consist of numerous little oval or rounded bodies, the sporules of the fungus having a diameter of about $\frac{1}{3000}$th part of an inch (fig. 49).

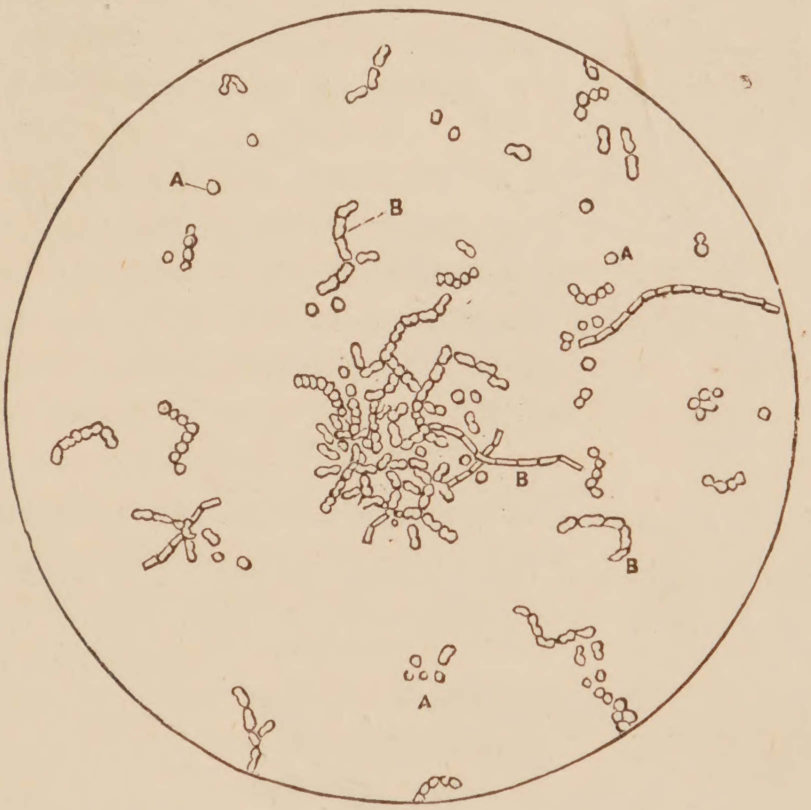

Fig. 49.*

A number of cells united end to end form simple or jointed and branching tubes (figs. 50 and 51), developed from the sporules (fig. 49). Little granules or nuclei may be seen in the interior of the spores. The tubes vary in diameter, and hairs in the vicinity of the favus crusts are impregnated with the fungus. The disease has been communicated by inoculation from man to man, and from mice to cats, and thence to man (BAZIN, DRAPER, FOX, ANDERSON).

Symptoms.—Favus is the most common and the most inveterate form of scald head. The disease commences with a slight pruritus or itching of a few hours' duration, followed by an eruption of small red *vari*, sensible to the touch and to the sight. These augment in size, and before twelve hours have passed, a yellowish point forms on each of their apices, at first so small as to be only visible under a glass of considerable power. The surface appears now as if covered with specks of a sulphur-yellow colour, and each *varus* appears as if set in the skin, with an umbilicated or depressed centre. If any fluid exudation exist, it does not remain so, but concretes into a dry, brittle, candied, honeycombed-looking scab or crust, which retains the form of the pustule, is similarly cupped or depressed in the centre, covered by the epidermis,

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* Fungus matter from a favus crust.—(A, A, A.) The isolated sporules; (B, B, B.) Chains of sporules (DR. ANDERSON).

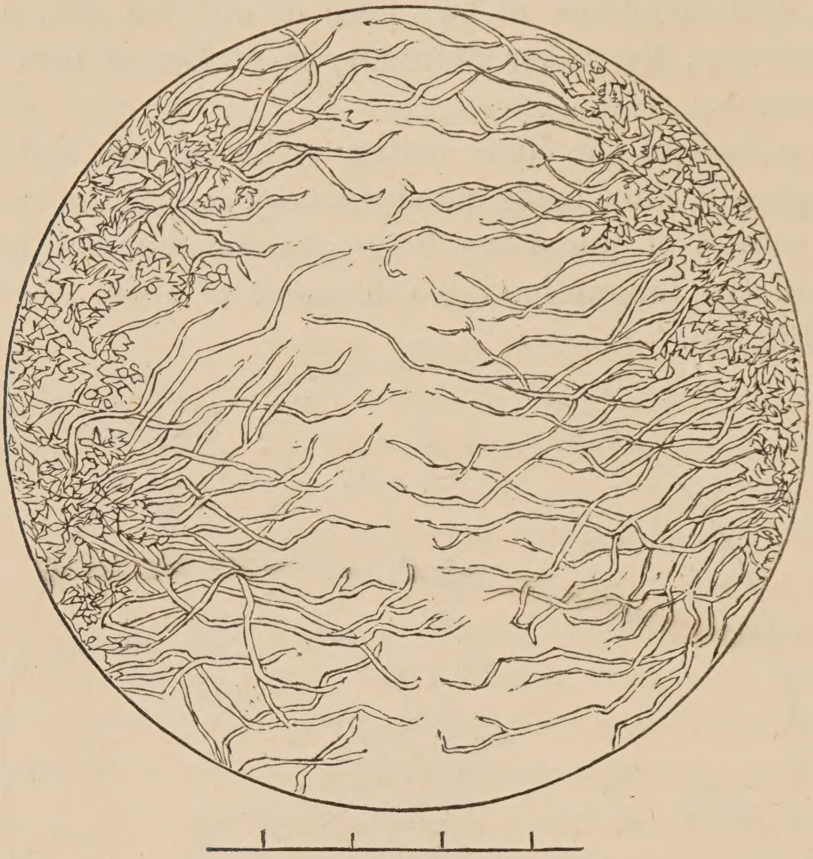

Fig. 50.*—$\frac{1}{1000}$th of an inch × 340 diameters (Dr. Anderson).

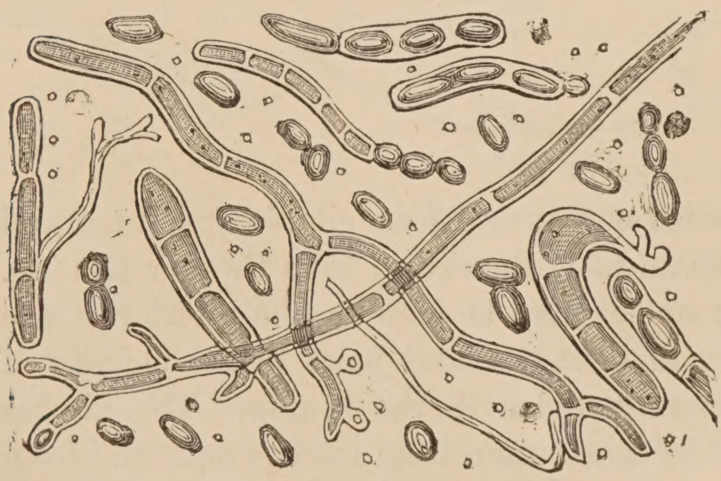

Fig. 51.†

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* Fungus matter from a favus crust, showing branching tubes running inwards to the centre of the figure from the epithelial scabs and sporules at the edges (Anderson).

† Showing the mode of reproduction of the *Achorion*, or fungus of the favus (after Bennett).

while its under surface is marked by a small mammary process which corresponds to the depression of the pustule. The honeycombed appearance of the scab gives the peculiar character of the disease, and hence the term "favus." The crust continues to increase, still preserving its circular form and depressed centre, till it occasionally attains a magnitude of five to six lines in diameter. When the crust is recent, it is of a yellow or fawn colour; as it becomes older its hue becomes lighter, and, as it is easily reduced to a powder, it has been compared to pulverized sulphur.

The number of favi is considerable, and they commonly appear in crops, affecting the same or different parts of the head at distant intervals. They may be either distinct or confluent. When very numerous, they are confluent, but the cupped form of the individual crusts may still frequently be recognized; and according to Rayer, should this peculiar form be lost through the copiousness of the secretion, still, by removing the superficial layers, each particular favus, with its central depression, may in general be made out. At a more advanced stage of the disease the epidermis disappears, and a viscid fluid is secreted in such abundance as to form one entire encrustation over the whole head; hence the *Porrigo larvalis*—mask or vizor-like scald head. The smell of the scab is peculiar, and has been compared to that of the urine of a cat, or of a cage in which mice have been kept. It is probably due to a species of alcoholic fermentation (*methylamine*) in connection with the vegetable growth (Lowe).

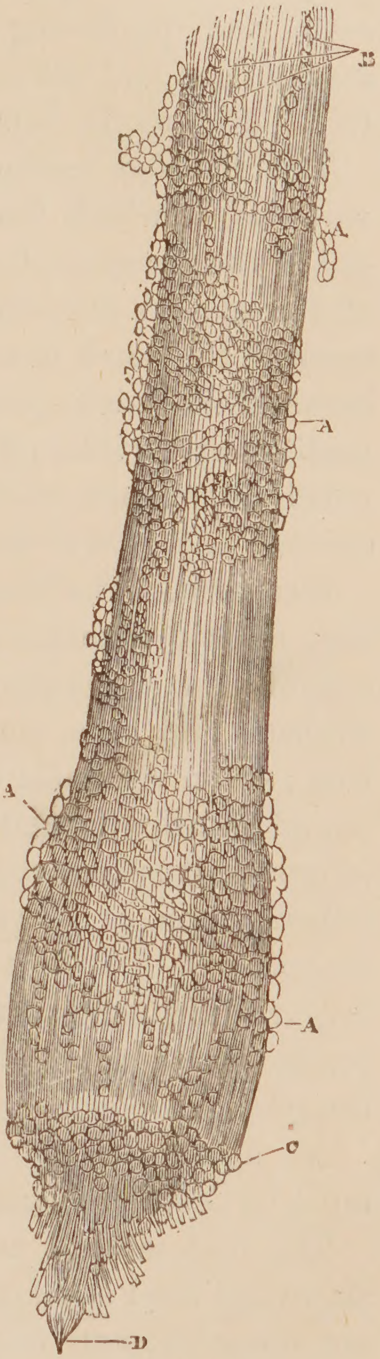

Fig. 52.*

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* Hair with favus fungus.—(A, A.) Chains of sporules projecting beyond the edges of the hair; (B.) Sporules between the fibres of the hair; (C, D.) Broken-up root end of the hair, with masses of sporules between the *laminæ* (after Kuchenmeister).

When a crust of recent formation is removed, a circular depression, wider and deeper than the favus, is seen. At a more advanced stage the ulceration penetrates below the dermoid tissue. Indeed, Alibert says he has never been able to remove a crust, for the purpose of making a preparation, without deeply wounding the scalp, and producing considerable hæmorrhage, while in some cases a deep and extensive ulceration takes place, which has penetrated even to the bones of the cranium.

The *Porrigo lupinosa* and *Porrigo scutulata* are accidental varieties, in which the scab resembles a lupine, rather than the cell of the honeycomb, and is very rarely seen; or the appearance of the scab is shield-like; and when of some extent and well marked, the patch is soft, doughy, and painful when pressed upon. Some of the hair appears to be removed by the roots, while other portions are broken off near the scalp, the roots remaining. Those which remain are readily removed by friction, and if pulled, have scarcely any hold of the scalp.

Treatment.—The treatment of the various forms of *favus* is now very strictly determined. Some practitioners, however, still rely entirely on a constitutional treatment, such as small doses of rhubarb and soda, small doses of mercury, some preparation of iron; or on vegetable tonics, as the infusion of cascarilla or compound infusion of gentian. With such treatment, if the health improves, it is believed the fungus will spontaneously disappear. Others, again, as entirely rely on a local treatment, attempting to exterminate the disease hy cauterization, or by applying some favourite ointment; and the catalogue of ointments used for this purpose includes all that have at any time been admitted into the pharmacopœia.

As in the last-described disease, the cryptogamous parasite must be destroyed, and its germs eradicated.

The best method to accomplish this is, in the first instance, to shave the head and apply a poultice till all the scabs, or nearly so, are removed; and this being effected, the whole hairy scalp, or site of the favus fungus, should be anointed with some of the following applications:—The *tar ointment* (*ungt. picis liquidæ*) has hitherto been the orthodox application. This ointment should be washed off night and morning with soft soap and water, and be as often re-applied. The head should be shaved twice or thrice a week, and where there are other children, the affected child should be isolated as much as possible, to prevent the disease from spreading. This form of porrigo, in the early stages, will sometimes yield by washing the part with the *oleum terebinthinæ* night and morning, and cutting the hair close.

The *Favus scutulata* is a disease often rebellious to every mode of treatment, but, applied at a favourable moment, a simple method may succeed. Dr. Willis has seen the disease yield to fomentations, or to bread poultices. The application of the lunar caustic round the patches, about a line from their outer margin, is another favourite method of treatment. In the latter periods of the disease, Dr. Willis recommends—

> A solution of *Sulphate of Copper*, in the proportion of seven grains to ten ounces of water; or of the *Nitrate of Silver* in the same proportions. The mild ointment of the *Nitrate of Mercury*, a salve of the black sulphuret of the same metal (Sulphuretum Hydrargyri Nigr., ʒj. ad ʒij. adipis ʒj.); the *Unguentum Picis*, an unguent of the *Cocculus Indicus* (ʒj. to ʒij. adipis ℥j.), may be tried one after the other; and in different instances each will have the merit of the cure.

The most effectual remedy is unquestionably the eradication of the affected hairs, and the use of such parasiticides as have been already mentioned under the different forms of *Tinea.* Dr. Anderson finds that when *favus* affects the head, all treatment is absolutely useless except *epilation.* The other methods are merely palliative—the disease re-appearing whenever the treatment is stopped. Dr. Bennet, of Edinburgh, places great faith in the olive oil treatment. It is very useful in many cases before proceeding to epilation. After the hair is cut short, and the favus crusts removed with poultices, the parts affected should be smeared thoroughly night and morning with fresh almond oil; and once or twice a week the head should be washed thoroughly with soft soap and warm water. After a few weeks of this treatment the hair becomes less friable, and *epilation* is much more easily and efficiently performed, and does not cause nearly so much local irritation. The hairs are to be removed *singly* with the forceps, not pulled out along with all the healthy growth in their neighbourhood, as used formerly to be done by the barbarous application of the pitch-cap.

This disease occurring on surfaces not particularly covered with hair yields at once to the application of a solution of sulphate of copper, or of the nitrate of silver in water, or to the solution of sulphurous acid as recommended by Dr. Jenner. The treatment of favus recommended by Robin and Bazin is epilation, and the application of the corrosive sublimate solution, or of acetate of copper ointment (1 part to 500 of lard), to kill the plant still remaining adherent to the hair follicle.

BALDNESS IN PATCHES—SYN., TINEA DECALVANS.

LATIN EQ., *Tinea decalvans;* FRENCH EQ., *Tinea decalvans;* GERMAN EQ., *Tinea decalvans*—Syn., *Alopecia areata;* ITALIAN EQ., *Tinea decalvans.*

Definition.—*A fungus disease, causing the formation of rounded or oval patches of baldness, sometimes solitary, more generally multiple. It affects the hairy scalp principally; but the beard, the genital organs, and hairy portions of the skin may also suffer.*

Pathology.—The fungus to which such circumscribed patches of baldness are owing has been named the *Microsporon Audouini*, detected by Gruby in 1843. It is present in the disease commonly called, after Willan, *Porrigo decalvans*, or *Alopecia circumscripta;* or, after Bateman, *Tinea decalvans;* by Bazin, *Tinea achromasota;* by Anderson, *Alopecia.* It differs from the *Trichophyton* of *Tinea tondens* by its numerous waved filaments, and by the extremely small size of its sporules. It is not found, like the *Trichophyton*, in the interior of the root, but forms round each hair a little tube; the hair then becomes opaque, softens, and breaks off (fig. 53). The *alopecia* is rapid, with or without previous *vitiligo* of the skin; the dermis is not congested, and the epidermis is thin and smooth. In the early stage of the disease the hairs appear dull and lustreless, and more easily extracted than healthy hairs. The skin is reddened, swollen, and slightly itchy. A whitish matter may be seen on the diseased skin and hairs, which is due to the sporules of the fungus. The hairs suddenly fall off from the affected parts, and a round bald patch is left, which is perfectly white, contrasting in its whiteness with the parts of the scalp or skin provided with hairs. The fungus may also be developed in the nail, like favus (BAZIN).

There is an affection which should be distinguished from the *Porrigo decalvans* (or *Alopecia circumscripta*), and which is characterized by a rapid disappearance of pigment from both skin and hair, with or without *alopecia*. M. Bazin includes it in his *Tinea achromatosa* (*Teigne achromateuse*), but does not mention the fact that *alopecia* is not constant; and states that a parasitic plant is present. It is probable, however, that something more than a fungus exists, to cause the total disappearance of pigment from a considerable portion of dermis. Besides, when the hairs return, they are at first quite white and downy, like those on children, and only gradually regain colour; whereas, if the *vitiligo* were owing to a plant, they would most likely not grow at all. The disease appears to be allied to those obscure pigmentary changes which have a much deeper seat than the surface of the body (Parkes). *Vitiligo* is sometimes a congenital affection, and seems to consist in an abnormal distribution of the pigment of the skin; so that there are irregular patches which are quite white, and altogether wanting in pigment, but are surrounded by skin provided with an excess of colouring matter. The hairs proceeding from the portion of the skin deprived of pigment are similarly colourless.

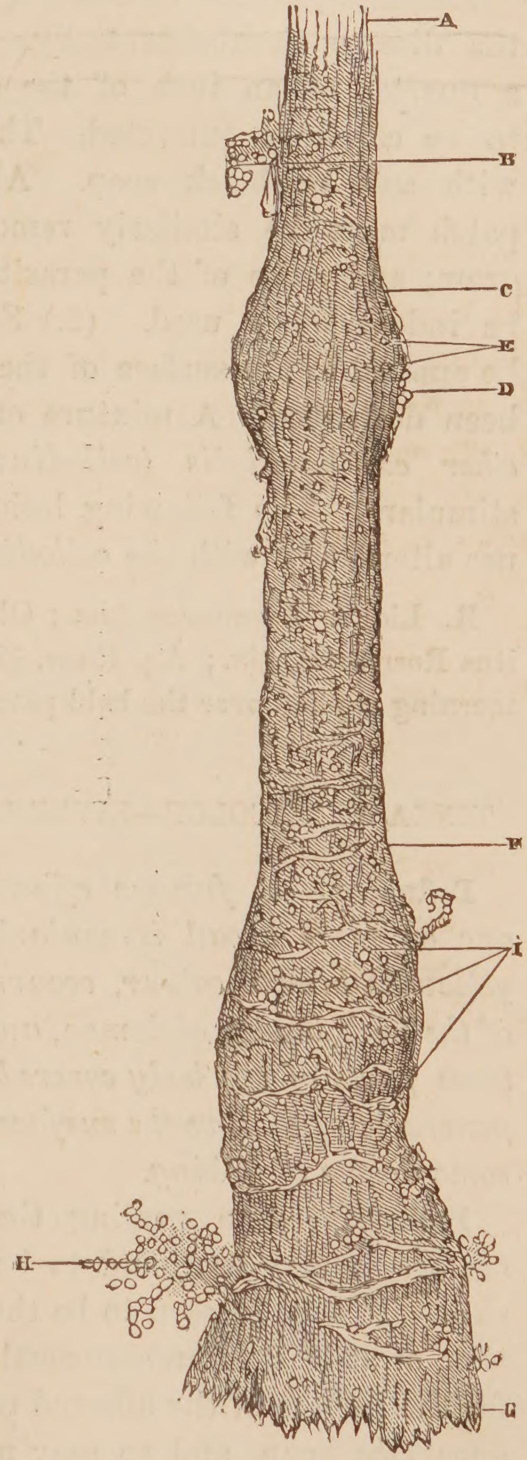

Fig. 53.*

The disease is not quite so readily transmitted as *Tinea tonsurans*, but still it is capable of being transmitted from one person to another, so that children so affected should be separated from their companions (Anderson).

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* Fungus of the hairs resulting in *Alopecia.*—(A, F.) Lower part of the hair; (F, G.) Root of the hair without the capsule; (C.) Spheroidal swelling of the hair, due to the accumulation of sporules; (E.) Between the longitudinal fibres of the hair; (D.) Rupture of the longitudinal fibres; (I.) Sporules and tubes of the parasite; (H.) A group of sporules proceeding from G, the ruptured root (Anderson).

Treatment.—This consists—(1.) In preventing the spread of the disease circumferentially. All the hairs, therefore, within a quarter of an inch of the circumference of the patch ought to be carefully extracted. The head should be washed daily with soft or black soap. All the *downy hairs* within the patch must be similarly removed till healthy hairs begin to grow; and some of the parasiticide lotions or ointments must be industriously used. (2.) Stimulants, or even blisters, must be applied to the surface of the bald patch after the fungus has been destroyed. A mixture of equal parts of *collodium* and of *ether cantharidalis* (*collodium vesicans*) is the most useful stimulant. The following lotion may be found advantageous to use alternately with the *collodium* stimulant, namely:—

℞. Liquor Ammoniæ, ʒiss.; Ol. Olivæ, ʒii.; Ol. Macidis, ʒss.; Spiritus Rosmarini, ʒiv.; Aq. Rosæ, ℥ii.; *misce bene.* To be used night and morning applied over the bald patches.

TINEA VERSICOLOR—LIVER-COLOURED SPOTS, OR CHLOASMA.

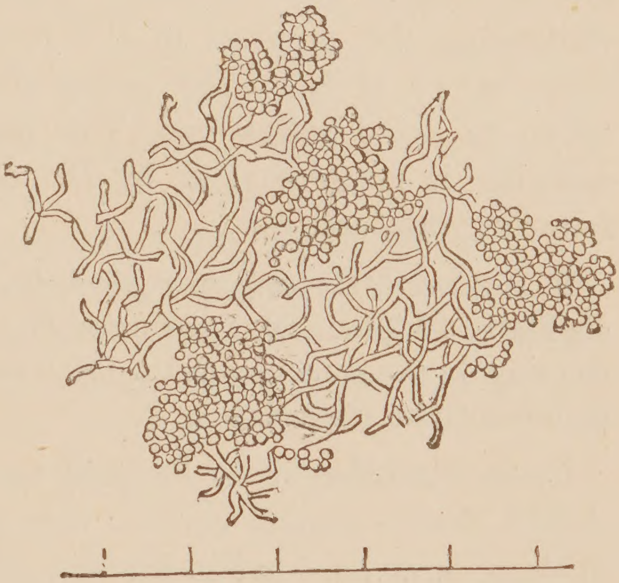
Definition.—*A fungus affection of the skin, characterized by one or more broad irregularly shaped patches of a yellow or yellowish-brown colour, occurring most frequently on the front of the neck, breast, abdomen, and groins, having a predilection for those parts of the body covered by clothing. The patches do not generally rise above the surface of the skin; and there is usually some degree of itching.*

Pathology.—On passing the hand gently over the diseased surface, it may be found to be less smooth than the surrounding skin. It may be seen to be the seat also of a very fine desquamation, or at least of an abnormal condition of the epidermis. Thus far the surface of the affected parts may have a *dusty-like* appearance, *like bran,* and so may merit the name of *Pityriasis versicolor;* but in no other respect has it anything in common with ordinary *pityriasis*—a disease altogether unconnected with parasitic *fungi.* The scales which desquamate from chloasma have a yellowish colour when contrasted with the white scales of such scaly diseases as *Pityriasis vulgaris* or *Psoriasis.* Hence the term Chloasma—from χλοος, "a greenish-yellow colour"—

appears more suitable than any of the other names by which the disease has been described.

The disease commences by little spots about the size of a pin-head, which tend to extend circumferentially; circular spots form and unite so as to produce large irregular patches, which may extend till the greater portion of the skin of the trunk is affected. The skin of the diseased parts has a peculiar brownish colour, but the depth of tint varies from the slightest increase of colour to a shade almost black. The colour has been said to resemble diluted bile.

A microscopic fungus, to which the name of *Microsporon furfur* was given by Robin, is the essential cause of the disease. It was discovered by Eichstädt in 1846. Soon afterwards it was described by Sluyter and by Sprengler, who gave a drawing of it. On putting a little of the dust from the desquamating surface under the field of the microscope, and adding a drop of *liquor potassæ*, scales of epidermis are seen mingled with the sporules and tubules of the fungus. The sporules are oval or rounded, and usually collected into large clusters like bunches of grapes, and are so characteristic as almost to be pathognomonic (ANDERSON). The tubes are short and branching.



1,000ths of an inch × 340 diameters.

Fig. 54.*

Dr. Anderson and Mr. Startin give numerous instances which prove that chloasma is a disease capable of being propagated from one person to another. It is a common affection with scrofulous persons especially, and may not unlikely be favoured by wearing the same flannel day and night, neglecting to wash the body for fear of catching cold (ANDERSON). It is not uncommon for such people to wear the same flannel next to

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[*] Shows the grape-like arrangement of the sporules and the short branching tubes of the *Microsporon furfur* in *chloasma* (after DR. ANDERSON).

the skin for a week, a fortnight, three weeks, and among the poor even for a month. And it is by no means an uncommon thing for them to wear the same flannel night and day, not once removing it from the moment it is put on till the time it is considered desirable to have it washed. The consequences of such habits are an accumulation on the surface of the skin of its secretion, and of undetached epithelium, and the consequent formation of a nidus favourable to the growth of the *Microsporon furfurans* (Dr. Jenner, *Med. Times and Gazette*, 1857, p. 651).

[illegible] - Hg
[illegible] Chlor
?

Treatment.—Local applications constitute the principal part of the treatment. *A solution of bichloride of mercury, in the proportion of two grains to an ounce of water*, applied over the affected parts once or twice daily, is generally effectual in destroying the progress of the fungus. Mercurial or sulphur baths have a similar effect, either singly or combined, care being taken to avoid salivation. The use of black soap night and morning is recommended by Dr. Anderson, or the use of the following mixture:—

℞. Bichloridi, Hydrarg, ʒi.; Alcoholis, ℥ss.; Saponis Viridis, et Aquæ distillatæ, ā ā ℥iiss.; Ol. Lavandulæ, ℈i.; *misce.* To be used night and morning, in the same way as the black soap; but if the gums get tender, its use must be suspended.

Great attention must be paid to cleanliness, and the patient should change flannel clothes very often, and should not sleep in them, or at least not in the same flannels that are worn during the day.

MYCETOMA—Syn., MADURA FOOT.

Latin Eq., *Mycetoma*—Idem valet, *Pes Madurensis;* French Eq., *Mycetoma;* German Eq., *Mycetoma*—Syn., *Madurafuss;* Italian Eq., *Mycetoma.*

Definition.—*A disease due to the presence of a mucedinous fungus, which eats its way into the bones of the tarsus, metatarsus, and lower ends of the tibia and fibula. In process of time it tends to cause death from exhaustion* (Carter, Berkeley).

Pathology and Historical Notice.—Dr. H. V. Carter, the Professor of Anatomy and Physiology at the Grand Medical College of Bombay, made a report in March, 1860, on this formidable fungus disease. It occurs in many parts of India and the north-eastern shores of the Persian Gulf. In the Bombay Presidency it has been seen at Kutch, Kattiawar, Guzerat, Scinde, the Deccan, and

Lower Koncan. On the Madras side it has been seen at Gumtoor, Bellary, Madura, Cuddapak, some parts of Mysore, and at Trichinopoly. In the Bengal Presidency it prevails to a limited extent round Sirsa; but patients come from Bicaneer, Bhawalpore, and Hissar. It is known amongst Indian medical men as the "fungus foot" or "fungus disease of India;" or under the scientific names of *Podelcoma* or *Mycetoma*, and by several characteristic native names. It is a disease which has hitherto occurred among natives only, and is undoubtedly due to the presence of a *mucedinous fungus*, which eats its way into the bones of the foot and lower ends of the tibia and fibula, penetrating or tunnelling through the tissues of the entire foot by numerous fistulous canals, tending to cause death by exhaustion, unless a timely amputation is made above the diseased part. The history of this disease is now rendered still more interesting from the fact that the Rev. M. J. Berkeley, M.A., F.L.S. (whose authority on *Cryptogamia*, and especially *fungology*, is well-known), has succeeded in developing a peculiar mould—the perfect condition of the species—from the black fungous masses sent to him by Dr. Carter. The nature of the disease has thus been more clearly determined; and the account here given is taken chiefly from the description of the disease by Mr. Berkeley, in the second volume of the *Intellectual Observer*, p. 248, and from the writings of Dr. Carter, in the *Bombay Medical and Physical Society's Transactions*, which he kindly sent to the author.

The fungus disease and material of the fungus assumes various forms, three of which may be considered typical:—

1. The first form is that in which the bones of the foot and the lower ends of the leg-bones, just above the ankle (for the disease never ascends higher), are perforated in every direction with roundish cavities, varying in size from that of a pea to that of a nut or pistol-bullet (fig. 55), the cavities being filled up with a dense fungous mass, of a sienna red within, but externally black, and resembling a small dark surface, from which a purulent fetid discharge is poured out, often accompanied by little pieces of the fungus. The masses and granules are imbedded in a whitish semi-opaque glairy substance of homogeneous consistence, while the walls of the canals have an opaque yellow tint, and are readily torn. The whole of the surrounding softer parts are converted into a gelatiniform substance, taking the place of muscles,

the tendinous and fatty structures being less readily changed. The foot presents externally the peculiar turgid appearance which it so often assumes in bad cases of scrofula. Besides the canals, pink stains or streaks are observable on the skin, and penetrating the subjacent tissues, filled with spherical or ovate groups of minute, bright orange-coloured particles, and containing occasionally a few larger cells, the nature of which has not at present been ascertained, though it is conjectured that they present the earliest appearance assumed by new attacks of the disease. (Specimens of the disease are to be seen in the Museum of the Army Medical School at Netley).

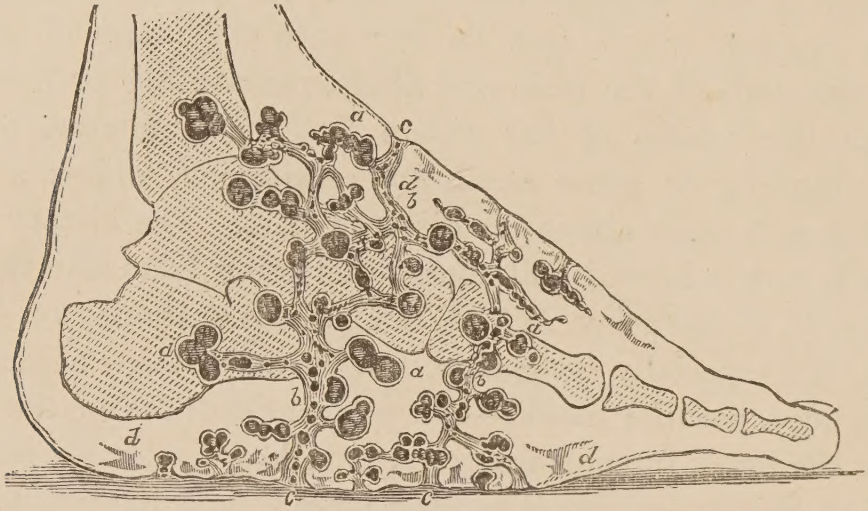

Fig. 55.*

* The figure represents the general appearance on section of the diseased foot in the fungus disease of India. It is based upon dissections, and on three sketches made immediately after amputation of the limbs (CARTER).

(*a*, *a*.) The *fungi*, some of which are globular and of large size, others smaller and more irregular, and others mere granules. The former are lodged in the spherical cavities in the bones. (*b*, *b*.) The *canals* in the soft parts and bones which lead to the free surface of the skin. They frequently communicate, and are lined by a continuous membrane: in them are contained the *fungi*. (In a diagram of this sort it is impossible to represent the soft glairy material which also occupies the canals.) (*c*, *c*.) The *apertures* on the surface where the canals terminate. They are often very numerous, and frequently in them may be seen impacted the black particles. (*d*, *d*.) The pink-coloured *stains* or *streaks* in the skin, above described. They are common to both varieties of the disease, and by them it is supposed the growth is multiplied.

It is to this variety of the affection that the term "fungus disease," which correctly expresses its nature, was, *par excellence*, originally applied. Hitherto no other instances of it have been distinguished, except those described by Dr. Carter; hence it may perhaps be regarded as comparatively unfrequent. The fungus particles or masses are of a deep black colour, and of firm consistence: they are sometimes as large and as round as a pistol-bullet.

Of the structure of these large truffle-like bodies, the figure (56) copied from the *Intellectual Observer*, from a specimen examined immediately after amputation, will give the reader an idea. The parts in which the structure is most visible present precisely the characters of a true *Oidium*, such as *O. fulvum*. Short, beaded, tawny threads arise from a common base, consisting of cylindrical articulated filaments, having at their tips large spore-like cells. These, however, do not appear to germinate *in situ*, but to become enormously dilated, their albuminous contents assuming at length a resinous consistence, while many of them burst, and nothing remains except fragments of the old cell-walls. The resinous matter is inflammable, but its exact chemical nature has not yet been ascertained.

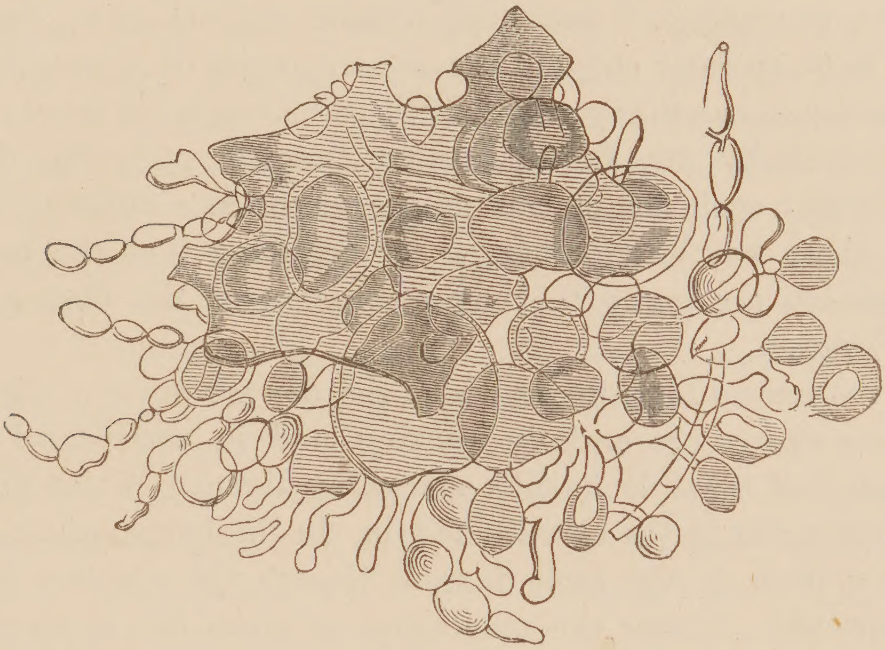

Fig. 56.*

The fungus of the foot resembles closely the genus *Mucor*, but there is no *columella* in the *sporangium*—a character which accords with *Chionyphe* rather than with *Mucor*. Indeed, there does not seem to be a single character in which the fungus of the Indian disease differs generically from the *Chionyphe*. Its mature form is seen to be composed of a thin filamentous stratum, spreading in every direction over paste, on which it may be propagated so as to form little slightly raised patches.

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* Structure of the truffle-like bodies, presenting the characters of *Oidium fulvum*, —short, beaded threads arising from a common base, consisting of articulated filaments, having at their tips large spore-like cells.

The species has been named by Mr. Berkeley as *Chionyphe Carteri*, the name serving to record the labours of the two Carters, "united in their love of science, though not in consanguinity." It is highly probable, as Mr. Berkeley observes, that many of our common moulds occasionally commence with a similar condition. The first indications of vegetation on tainted meat or paste assume the form of little gelatinous spots, of various colours, consisting of extremely minute distinct cells, and these seem to be an early stage of a common species of *Aspergillus* and *Penicillium*, or other genera. If there be any truth in the notion entertained by Mr. Berkeley, that hospital gangrene depends upon some vegetation of this nature, acting as a putrefactive ferment, there may be good reason for believing that the red spots in question are really the commencement of the disease under consideration.

In the second form under which the disease appears the black fungous masses are entirely wanting, and in their stead masses are found of what looks like sloughing tissue. White granules, however, occur in the cavities and in the discharge, which appear to be a form of the same fungus, though the identity has not been proved. Under the microscope it wears the appearance of a congeries of large cells filled with smaller ones. Whether the perfect form of the plant be the same or not, the phases of the disease produced by it are exactly the same, and the malady admits of no other remedy than amputation of the foot.*

A third form of the disease is known under the name of the *Madura foot*, from its having occurred at Madura. In this case the foot becomes enormously enlarged about the instep, though not so much at the ankle, while the toes are hypertrophied, and almost lost or imbedded in the mass. The small bones are nearly destroyed, leaving behind a pallid or reddish tissue, while the others are more or less excavated. There are the same canals and external sanious apertures. In some parts they are filled with the same fleshy tissue, in others lined with it, where large cavities are formed by the junction of several canals, containing broken-up osseous tissue from the exposed bones around, grey fragments, and masses of pigment. The pink colour is partly owing to a general diffusion of pigment, which tinges the oil-globules, and partly to the presence of very numerous single or aggregated elliptic particles. These granules are from the $\frac{1}{50}$th to the $\frac{1}{30}$th of an inch in diameter, and occur sometimes as single ellipses, sometimes as two combined at the extremities of their major axes, and sometimes as square bodies with rounded extremities, divided into four. They are quite visible to the naked eye, insomuch that, when the sawn surface is first exposed to view, it appears as if strewed with grains of red pepper; and pains were therefore taken by Dr. Carter to assure himself that they were not particles accidentally introduced through the open window. Further examination convinced him that, though different in colour, they were similar in essence to the granules described in the second form. None of the black fungous masses appeared, but there were globular opaque bodies of various sizes, which now require notice, and which, though at first apparently so different, are closely connected with the fungus of the first form. The foundation of these bodies consists of one or more large mother-cells filled with a mass of daughter-cells. These are clothed externally with a radiating growth, assuming a vast variety of forms. The structure often so exactly simulates that of minute moulds, that it is very difficult to get rid of the notion that they are really vegetable growths. Pure sulphuric ether, however, dissolves them completely, and shows that they are merely different forms assumed by stearine. Sometimes the white mass consists of straight slender threads radiating in every direction, each of which is surmounted by a globose or elliptic spore-like body, while occasionally the threads or crystals are shorter and the globe irregular. Sometimes the globules are absent, and in one case the fundamental cell budded like the receptacle of an *Aspergillus*, each new cell being separated by an articulation and supported on a short stalk.

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* In the *second variety of Mycetoma* we find three or four different kinds of particles: these, however, are always light-coloured and soft, and generally very small or minute. Of them only one form, certainly the more common, has been noticed by writers: it is that in which each particle is seen to be invested by a crystalline coat. The truly fungus nature of the more common kinds of granules or particles, and of that striking instance of the disease from Madura, is as yet only matter of inference.

It seems desirable that every step in the investigation of this disease (the elucidation of which is committed, as it were, to the medical officers of India) should be based on direct and repeated observation, and that speculation be refrained from as being at least useless.

Sometimes the outer coat consists of regularly dichotomous or trichotomous fascicles of linear crystals, which are free above.

Sometimes, on the contrary, the fascicles are dilated above with ciliary processes, or labiated; while occasionally there are straight radiating bodies surmounted by a globular mass, pierced and surrounded by cilia. Another form appears under the guise of little feathers; while a not unfrequent one consists of leaf-like, oblong, strongly accuminate scales, simulating the leaves of mosses. *The foundation is, however, in every case, an organized cell, the red colour of whose daughter-cells is precisely that of the oidium-like threads of the black fungus.* Whatever may be thought of the second and third forms of vegetable growth, this at least must be considered as identical with the first, though at present the *Chionyphe* has not been propagated from its globules—so closely involved in stearine that their germination is scarcely probable. There is not the slightest ground for supposing that the disease depends on inoculation

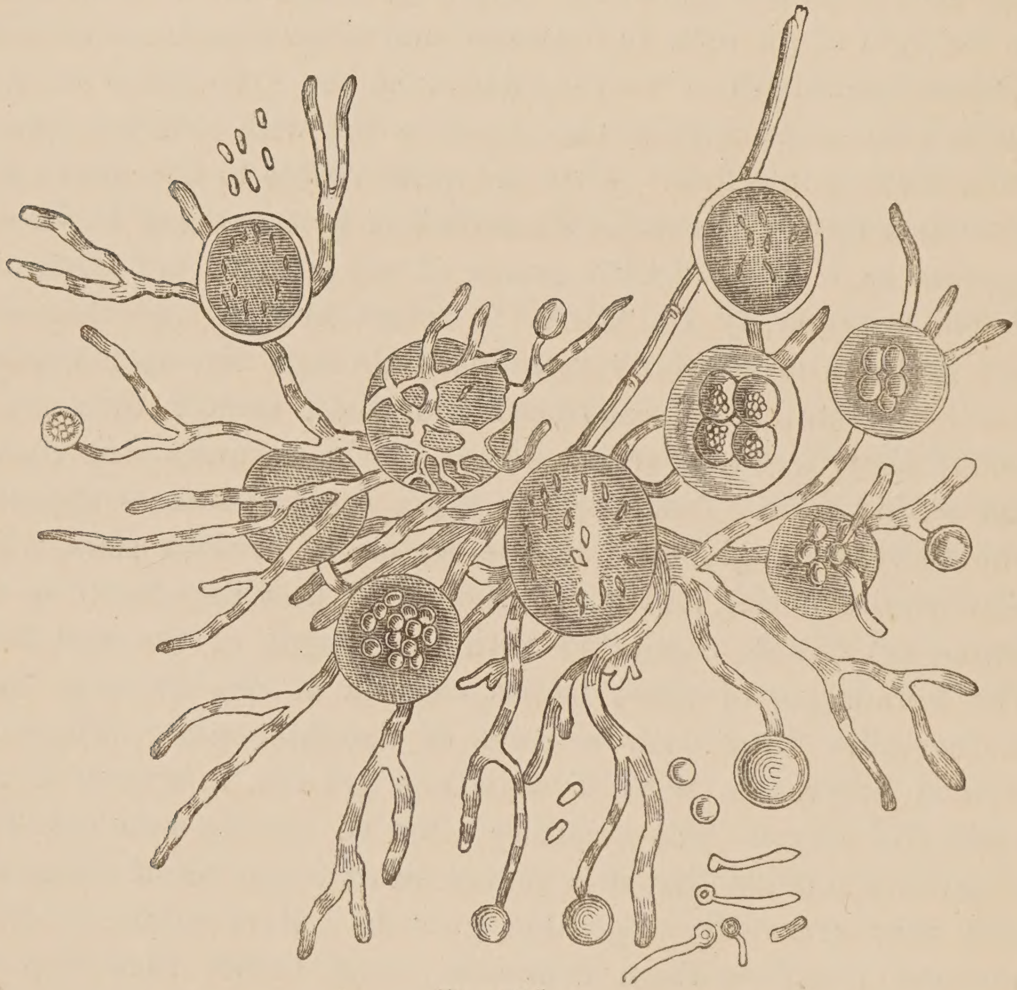

Fig. 57.*

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* Fundamental cells of the *Chionyphe Carteri* developed from the *fungus foot of India*, budding like the receptacle of an *Aspergillus* (BERKELEY and CARTER).

with the spores of any of the truly parasitic *fungi* belonging to the tribe of *rusts* and *mildews,* but great reason, on the contrary, for looking to the origin of the fungus of the foot amongst the *mucors,* even were there not something like direct proof. It is well known that *mucedinous fungi* make their appearance within cavities of vegetables which have no apparent connection with the outward air. Nothing, for example, is more common than to find a pink mould (*Trichatherium roseum*) in the middle of a nut, and an allied vegetable production (*Dactylium soyerium*) has been found in an unbroken egg. Even the cells of plants themselves produce *fungi* which fructify within them. How the spores are carried there is at present a mystery which may some day be cleared up, as the origin of many intestinal worms has been, which can no longer be brought forward as an argument for equivocal generation.

The fungus foot is confined to the natives of India, who go about with naked feet, and the spores might easily be introduced through some scratch, even were it impossible for them to penetrate by the pores of the skin. When once introduced beneath the cuticle, a single spore might soon perform the work of destruction, spreading in every direction, and, according to the peculiar condition of the secretions, the *mycelium* might put on a hundred different modes of growth. Besides, if the fungus is capable of causing the absorption of solid structures like bone, it is easy to conceive that a spore, in contact for sometime with a moist foot, might penetrate the cuticle simply by absorption. Cleanliness, in the first instance, seems to be a preventive; but when the fungus is once established, there seems to be no cure save amputation—which, happily, when resorted to in time, appears to be completely successful, as the disease never spreads beyond a certain point, though, if it be allowed to take its course, death will ensue from the exhaustion consequent on pain and the continuous discharge.

In some cases it would seem as if the foot had been in a diseased state when the fungus was introduced; at least, the history of one case, which apparently commenced with a boil on the instep (which was treated by native doctors, a thorn being used several times as a lancet), indicates a lesion such as might well encourage the growth of a fungus parasite.

It is more than twenty years since surgeons in India first took notice of this affection of the foot in their official reports; and one of the earliest to notice the disease was Dr. Colebrook, of Madras, then Zillah-surgeon at Madura, where the endemic character of the malady was first recognized by the term "Madura foot." An interesting account of the disease was afterwards published by my friend Dr. G. R. Ballingall, who was the first to describe the microscopic peculiarities of the disease, and he was led at once to distinguish at sight the tumor of the foot from any simple scrofulous affection, and to detect the prominent features by which he recognized the fungus foot as something *sui generis.* "Cases of diseased foot," peculiar to certain parts of the Bombay Presidency, were recorded by Assistant-Surgeon Bazunjee Rustomjee, in the fifth vol. (N. S.), p. 230, of the *Transactions of the Medical and Physical Society of Bombay*, and which Dr. Carter considers are "the most fully and carefully recorded instances of the 'fungus disease'" which had been published at the time Dr. Carter wrote his report. Most of the cases belong to the second form of fungus described in the text; and practically the disease is regarded in India as a species of *caries.*

Symptoms.—In the first variety the general form of the foot is oval, being much enlarged about the ankle and over the instep. On either side of the ankle-joint, on the dorsum of the foot near the toes, likewise on the sole, are numerous small soft swellings or tubercles, as large as a pea or marble, having pouting, puckered apertures, leading to fistulous canals; and the skin surrounding these apertures appears lighter in colour than elsewhere. (See specimens in the Museum of the Army Medical School at Netley.) The canals sometimes lead directly to the bone; and a discoloured glairy fluid, which exudes from the canal, sometimes carries with it a few black, gritty particles. The toes are distorted and displaced upwards, and the muscles of the calf of the leg atrophied. Such a condition has been known to exist for more than twelve years; and the natural course of the disease is fatal. The external characters of the other forms are similar to those already described.

The changes produced in the bones, as shown by maceration, are of such a kind that a cursory examination of them at once suggests the conclusion that some *organic* agency has been at work to produce the changes. The cancellated tissue becomes the seat of cavities more or less spherical, and sometimes most perfectly so. These cavities vary in size from little more than that of a pin's head to that of a round bullet; and the walls of the cavities are formed by open cancellous tissue.

From being in close juxtaposition, they frequently open into each other, producing large vaulted gaps or spaces; and not only so, but every cavity, large or small, has an open communication, directly or indirectly, with the external surface. In the more superficial ones some part of the wall is wanting, so that the cavities look like mere round holes of various depths; but in the deeper cavities a regular tunnel, more generally straight than curved, serves as the channel of communication. The diameter of these passages is sometimes equal to that of the cavities themselves. In the recent state the sinuses of the soft parts are often plugged up by superficial collections of the fungus; but when cleared out, they are found to lead down to the tunnelled passages, or into the rounded holes—the peculiar *loci* of the *fungus*. The fungus has only once been seen affecting the hand (COLEBROOK).

Description of Incipient Fungus Disease.—The lesion has the appearance of an elongated flattened tumor, the rounded surface of which is marked with white patches, and presents seven circular depressed spots of one-third to one-half inch, or more, in diameter. The superficial dark layer of cuticle is cast off, leaving a very regular circular white surface, the centre of which presents a depression, closed at the bottom by a brownish layer, very thin in the middle. It was found on section that a small cavity existed beneath this depressed spot, or a tubular prolongation was detected running down through the remaining thickened cuticle and cutis into the subcutaneous cellular tissue, where it was not difficult to find the fungus particles, pink or yellowish-coloured, and also in the cavity above named, in the superficial part of the cutis, or even on the surface of the latter,—the cuticle being raised.

Another and smaller specimen most clearly showed the development of the *fungi* at the very spot where, in all probability, their germs were first produced. In other parts there is a prolongation of the growth into the subjacent tissues, and there pink-coloured particles were to be seen. The local nature of the whole affection—its very beginning—was here unmistakably displayed; and the superficial appearance of the skin gave the impression that a vesicle or blister had once existed there, not at all unlike that left after a *Guinea worm* has begun to discharge, as it is well known that the end of the worm makes its appearance in the centre of such a circular spot.

A further examination of the fungous particles showed their perfect resemblance to those of older specimens, and bodies not unlike spores were occasionally seen.

END OF VOL. I.

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